A REVISION OF THE LIZARD GENUS *SCINCUS* (REPTILIA : SCINCIDAE)

BY

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SYNOPSIS

Until recently, up to thirteen species of the scincid genus, *Scincus*, were recognized, but examination of some 590 individuals from a wide range of localities suggests that only three or four are valid. Of these, *S. mitranus* is confined to eastern and southern Arabia and *S. hemprichii* probably to southwest Arabia. The remaining forms constitute the *S. scincus* complex, which may consist in North Africa of two largely allopatric species, *S. scincus* and *S. albifasciatus*, although evidence for this is not conclusive. The *S. scincus* complex is represented in southwest Asia by two forms: *S. scincus meccensis* in southern Jordan, northwest and west Arabia and *S. s. conirostris* in southern and eastern Arabia, Iraq and southwest Iran.

Scincus appears to have evolved from a primitive scincine, very similar to members of the *Eumeces schneideri* group, especially *E.* (*schneideri*) *algeriensis;* it does not seem to be directly related to the sympatric genus *Scincopus*. Within *Scincus*, the *S. scincus* complex is the least specialized component of the genus and both *S. mitranus* and *S. hemprichii* may have been independently derived from it, or from a closely related form. Possibly the whole range of the genus was once occupied by a *S. scincus*-like species and its distribution was subsequently restricted by the onset of less desertic conditions leaving reduced populations in North Africa, southwest Arabia and southeast Arabia that gave rise to the *S. scincus* complex, *S. hemprichii* and *S. mitranus* respectively. A renewed expansion of arid areas could then have enabled the *S. scincus* complex to invade southwest Asia. Some of the characters of its most eastern subspecies, *S. s. conirostris*, may have arisen, or been maintained, by character displacement through contact with *S. mitranus*.

INTRODUCTION

THE scincid lizard genus *Scincus* Laurenti, 1768 is a clearly-defined group of species adapted to life in areas of loose, usually wind-blown sand. It is distributed from the western Sahara Desert and its borders, eastwards to Arabia, southern Iraq and southwestern Iran.

Scincus falls clearly within the assemblage of relatively primitive skinks referred to the subfamily Scincinae by Greer (1970). Like the majority of these, *Scincus* has a more or less unmodified lacertilian palate in which the palatine bones do not meet on its mid-line, although they are opposed above it. The members of most scincine genera have elongate bodies and reduced limbs and often the nostril is situated in, or broadly bordered by, the rostral scale (instead of being pierced in a separate nasal scale or between two such scales). *Scincus* has none of these specialized features and is thus similar to the Saharan genus *Scincopus* Peters, 1864 and the Holarctic *Eumeces* Wiegmann, 1834. It seems likely that these three genera are among the more primitive living scincines.

Scincus can be distinguished from *Eumeces* and *Scincopus* by its single premaxilla, its postorbital and postfrontal bones which are completely fused from earliest life,* and by possessing a wide range of morphological adaptations to living in loose sand. These include: fringed digits to increase purchase; streamlined body shape including a spatulate snout with bony rostral support; powerful body musculature to facilitate sand-swimming; mechanisms to allow breathing beneath the sand; protected orifices to keep sand out, e.g. very small ear apertures, valvular nostrils, countersunk jaw; and often some modifications of the ear that may well facilitate subterranean hearing and increase the sensitivity of spatial orientation. These features will be discussed more fully elsewhere.

Numerous taxa of *Scincus* have been described and some thirteen species, plus a further two subspecies, are either recognized or have only recently been called into question. Mertens (1972), the last worker to discuss the genus, lists the following forms: *Scincus albifasciatus* Boulenger, 1890; *S. arabicus* Schmidt, 1939; *S. arenarius* Murray, 1884; *S. conirostris* Blanford, 1881; *S. deserti* Haas, 1957; *S. gasperetti* Haas, 1957; *S. hemprichii* Wiegmann, 1837; *S. meccensis* Wiegmann,

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* Checked on numerous *Scincus* and on at least one specimen of each of the following species; *Scincopus fasciatus* Peters, 1864; *Eumeces blythianus* (Anderson, 1871); *E. brevilineatus* Cope, 1880; *E. brevirostris* (Günther, 1860); *E. chinensis* (Gray, 1838); *E. dugesii* Thominot, 1883; *E. egregius* Baird, 1858; *E. elegans* Boulenger, 1887; *E. fasciatus* (Linnaeus, 1758); *E. inexpectatus* Taylor, 1932; *E. latiscutatus* (Hallowell, 1860); *E. longirostris* (Cope, 1861); *E. lynxe* (Wiegmann, 1834); *E. marginatus* (Hallowell, 1860); *E. obsoletus* (Baird & Girard, 1852); *E. oshimensis* Thompson, 1912; *E. quadrilineatus* (Blyth, 1853); *E. schneideri* (Daudin, 1802); *E. septentrionalis* (Baird, 1858); *E. skiltonianus* (Baird & Girard, 1852); *E. sumichrasti* (Cope, 1866); *E. taeniolatus* (Blyth, 1854). In *Eumeces* the postorbital and postfrontal bones are at least partly separate in young animals and often in adults as well.

1837 ; *S. mitranus* J. Anderson, 1871 ; *S. muscatensis* Murray, 1886 ; *S. philbyi* Schmidt, 1941 ; *S. richmondi* Haas, 1961 ; *S. scincus scincus* Linnaeus, 1758 ; *S. s. cucullatus* Werner, 1914 ; *S. s. laterimaculatus* Werner, 1914.

Many of these taxa have been described from very small samples, and sometimes on the basis of single specimens. Furthermore, the characters used in defining species often only involve minor differences in colour and scaling, some of which are now known to be quite variable even within populations. It therefore seems desirable to reassess the validity of the numerous taxa of *Scincus*. The situation is particularly acute in Arabia where no less than ten species have been described.

The main aim of this account is the recognition of biological species within the genus *Scincus*. Infraspecific geographical variation is also described, but a conservative attitude has been taken towards the use of formal subspecies names. These have only been employed in cases where geographical groups of populations differ fairly consistently from neighbouring groups in at least three independent features. Even when this is so, formal names have not been applied unless the apparent infraspecific unit concerned is known from a reasonable number of examples. It will become obvious that, if a less stringent working definition is used, far more subspecies of *Scincus* could be recognized, but this seems undesirable. Many widespread species have complex patterns of variation that do not really lend themselves to description by the formal naming of numerous, often arbitrary, segments of the range. It seems best in such cases to describe geographical variation as such and to reserve subspecific names for entities that are capable of very clear definition. It is of course sometimes possible, using multivariate techniques, to define objective infraspecific entities, even although there are no consistent individual character differences between the forms concerned (see, for instance, Thorpe's (1975) treatment of the east and west populations of *Natrix natrix*), but as no sophisticated numerical methods have been used in the study of *Scincus*, no attempt to discover such hidden entities has been made here.

MATERIAL EXAMINED

Material looked at in the course of this study is listed at the end of each species description. Data in brackets were not originally attached to the specimens, but have been added by the present authors. Localities for which no co-ordinates are given can be found in *The Times Atlas of the World, Mid Century Edition*. Where the spelling differs markedly from that attached to the specimens the *Times Atlas* spelling is given in parentheses. Abbreviations used are as follows :

BM	British Museum (Natural History), London
AMNH	American Museum of Natural History, New York
CAS	California Academy of Sciences, San Francisco
CM	Carnegie Museum, Pittsburgh
EBD	Estación Biológica de Donaña, Seville
FMNH	Field Museum of Natural History, Chicago
HUJ	Hebrew University of Jerusalem
IFAN	Institut Fondamental d'Afrique Noire, Dakar
MCZ	Museum of Comparative Zoology, Harvard

MF	Museo Zoologico dell'Università di Firenze
MHNP	Muséum Nationale d'Histoire Naturelle, Paris
MSNG	Museo Civico di Storia Naturale 'Giacomo Doria', Genoa
NMW	Naturhistorisches Museum, Vienna
SMF	Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt a.M.
USNM	United States National Museum, Washington
ZMB	Zoologisches Museum an der Humboldt-Universität zu Berlin
ZSM	Zoologische Staatssammlung, Munich

ad.	Adult of undetermined sex
juv.	Juvenile (arbitrarily defined as any *Scincus* under 70 mm)
*	Ear dissected

As the manuscript was almost entirely written at the British Museum (Natural History), the greater part of the material, including that from most other institutions, was examined there. However, California Academy of Sciences specimens and a few individuals belonging to the Field Museum of Natural History, Chicago, were checked by the junior author at the former institution ; unlike the rest of the material, these were not sexed.

Specimens used for checking osteological features are in the collection of the British Museum (Natural History) ; radiographs and a list of the individuals employed are also deposited there.

The number preceding each sample correlates with those indicating localities on the distribution maps (Figs 5–7).

CHARACTERS ALREADY USED OR POTENTIALLY USEFUL IN CLASSIFYING *SCINCUS*

It will become apparent that *Scincus* can best be regarded as three well-defined entities, as follows :

1. *S. hemprichii.*
2. *S. mitranus* (including *S. arabicus*, *S. arenarius*, *S. muscatensis*, *S. philbyi* and *S. richmondi*).
3. The *S. scincus* complex, which consists of two apparently well-defined subspecies east of the Red Sea and a less easily analysed series of populations in northern Africa (for which the following names are presently in use : *S. s. scincus*, *S. s. cucullatus*, *S. s. laterimaculatus* and *S. albifasciatus*). The two eastern subspecies are *S. s. meccensis* (including *S. deserti*) and *S. s. conirostris* (including *S. gasperetti*).

To simplify description of characters, the forms listed inparentheses will be included in the taxa recognized above unless otherwise stated. For the present, North African populations of the *S. scincus* complex will be referred to informally as such.

The ear and associated structures

The size and position of the external ear opening have long been used in the classification of *Scincus*. Differences in these features turn out to correlate with more profound modifications of the ear and surrounding parts of the skull. These may well represent varying degrees of adaptation to the problems of subterranean hearing and spatial orientation.

The ear of *Scincus* corresponds fairly closely to the typical lacertilian pattern described by Baird (1970). However, it is slightly anomalous in having a relatively long external auditory meatus that runs forwards and downwards to a small exterior aperture. Features of the ear and associated structures that exhibit variation within *Scincus* are described below and illustrated in Figs 1–4.

EXTERNAL ORIFICE OF THE EAR. *S. scincus* complex. The external orifice of the ear is relatively large and its upper margin is situated just above, or almost level with, a continuation of the line made by the free edges of the upper labial scales. It is nearly always covered by two flat, closely connected scales that have their posterior borders strongly serrated to produce a fringe; in most cases the free upper edge of the lower scale overlaps the lower edge of the upper one. Serration is very variable, but often two principal lobes can be discerned on each scale.

In a few instances, the upper part of a third scale is involved in the lowermost region of the fringe and, very rarely, there is only a single large scale covering the ear orifice.

S. mitranus. Here the ear orifice is considerably smaller than in the *S. scincus* complex, and its upper margin is nearly always well below the level of the line made by the free edges of the upper labial scales. The orifice is also often displaced forwards when compared with that of *S. scincus*. As in this species, it is covered by two scales in most cases, although since the orifice is very small, it is only the contiguous parts of the two scales that lie over it. The overlying area is again usually serrated although the denticulation is typically far less than that found in the *S. scincus* complex. The two scales covering the ear sometimes coalesce and this fusion may be so complete that they appear as a single scale, which may have only very reduced serration on its posterior margin.

S. hemprichii. In this species, the ear orifice is minute and situated well below the level of the line made by the free edges of the upper labial scales. It is placed deep beneath a single large, unserrated scale which may have arisen by fusion of two smaller scales (as in some *S. mitranus*, see above).

EXTERNAL AUDITORY MEATUS. *S. scincus* complex. The meatus is relatively short and, distally, is quite thick-walled and lined by obvious, although unossified, well-spaced scales, the overlapping edges of which are directed towards the external orifice. More proximally, the meatal wall becomes membranous, except for a cartilaginous plate that is incorporated into its lateral surface and originates from the superior outer border of the quadrate. This plate tapers distally to a point and is relatively short. The more proximal part of the meatus is usually well covered with muscle and clearly separated from contact with the overlying skin.

S. mitranus. The meatus is considerably longer than in the *S. scincus* complex. As in this species, its distal portion is lined with scales, but these are less well developed and the meatal wall in this area is thinner. The proximal part of the meatus is again membranous, except for the cartilage in its outer (lateral) wall which is much longer and more pointed than in the *S. scincus* complex. The lateral wall of the proximal part of the meatus lies close to the skin and is only separated from it by a thin layer of muscle.

S. hemprichii. The meatus is fairly long (although rather shorter than in *S. mitranus*). The lower section is very thin-walled and either lacks scales or has only scattered traces of them. The cartilaginous plate in the membranous proximal part of the meatus is relatively short and broad. This area lies close to the skin.

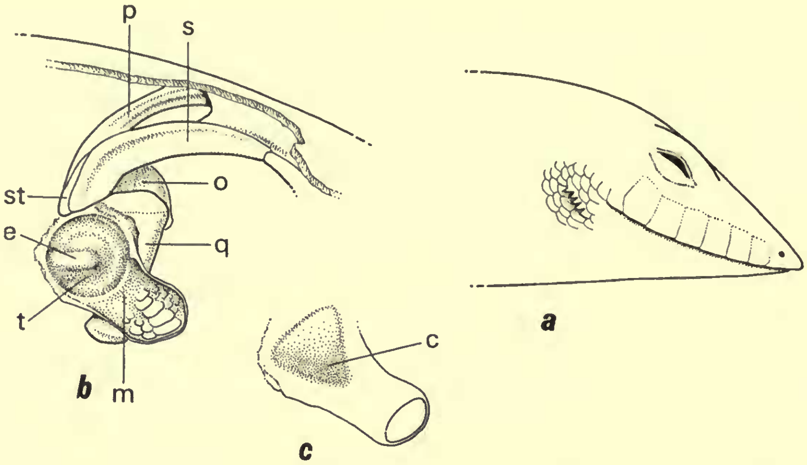

FIG. 1. *S. scincus:* ear and associated region of skull. **(a)** Head showing position of external orifice of ear. **(b)** Diagrammatic exposure of outer ear and hind part of skull. Abbreviations (reading clockwise from top) are as follows : p = supratemporal process of parietal ; s = squamosal ; o = otic capsule ; q = quadrate ; m = external auditory meatus (lateral wall removed) ; t = tympanum ; e = extracolumella ; st = supratemporal. **(c)** External auditory meatus showing cartilage (c) in lateral wall. (Based on BM 1909.7.28.15 ; El Oued, Algeria ; ♂.)

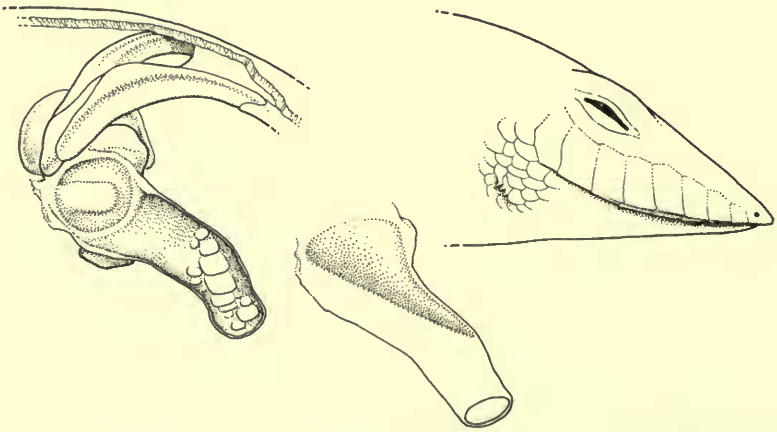

FIG. 2. *S. mitranus:* ear and associated region of skull : compare with Fig. 1. (Based on BM 1970.1594 ; Sharjah, United Arab Emirates ; ♂.)

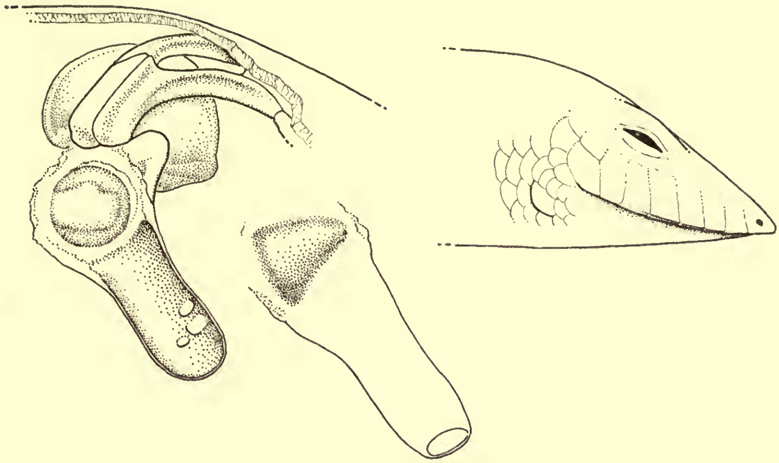

FIG. 3. *S. hemprichii:* ear and associated region of skull: compare with Fig. 1. (Based on BM 95.5.23.77; Haithalhim, Aden; ♀.)

QUADRATE AND TYMPANUM (Fig. 4). The quadrate bone and the tympanum are largest (when compared with skull length) in the *S. scincus* complex. In *S. mitranus*, they are both slightly smaller and the tympanic crest of the quadrate is better developed. *S. hemprichii* has a smaller quadrate still and the tympanum is further reduced so that it is smaller than in the other two species, both relative to skull length and to quadrate size. The quadrate in *S. hemprichii* usually has a more prominent antero-superior projection than the other species.

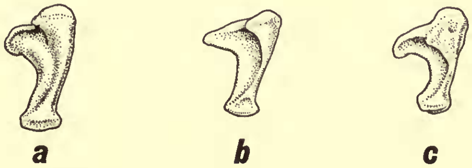

FIG. 4. Right quadrates of **(a)** *S. scincus*, **(b)** *S. mitranus* and **(c)** *S. hemprichii*; lateral view. (Based on specimens used for Figs 1–3.)

EXTRASTAPES AND STAPES. *S. scincus* complex. The extrastapes has a distinct *pars superior* and *pars inferior* embedded in the tympanic membrane. Together, these *partes* form a clearly defined, slender bar running gently forwards and often downwards from the posterior border of the tympanum (where the *pars superior* is attached) to beyond its centre. The stapes is slender and terminates in a relatively small footplate at the *foramen ovale.*

S. mitranus. The *pars superior* and *pars inferior* are expanded to form an elongate cartilaginous plate that involves a comparatively large area of the tympanum. The size of the plate varies somewhat but it is always relatively larger than the combined *pars superior* and *pars inferior* of the *S. scincus* complex. Also, the stapes of *S. mitranus* is slightly more robust and has a larger foot-plate.

S. hemprichii. The combined *pars superior* and *pars inferior* is larger still and forms an often irregular, ovoid, cartilaginous plate that may occupy all but the periphery of the tympanum. The stapes of *S. hemprichii* is much more robust and has a larger foot-plate than other species of *Scincus*.

OTIC CAPSULE. *S. scincus* complex. The otic capsule is fairly large in young animals but decreases in relative size with growth. In adults, its posterior border is not, or only slightly, visible in lateral view.

S. mitranus. Here the otic capsule is about the same length or only slightly larger than that of equivalent-sized members of the *S. scincus* complex, but its posterior border is often clearly visible in lateral view, partly because the squamosal and the supratemporal process of the parietal usually descend at a more abrupt angle in this species.

S. hemprichii. This species has an immense otic capsule that may occupy a substantial proportion of the space beneath the supratemporal process of the parietal which is more usually occupied by parts of the jaw musculature. The capsule extends about as far forwards as the epipterygoid bone and projects backwards well beyond the confines of the skull.

Otic enlargement in *Scincus* mainly involves the upper part of the capsule containing the semicircular canals. The lower section shows much less variation in size. In animals with a skull length of about 20 mm (excluding rostrum) the otic capsule is about a quarter of this length in the *S. scincus* complex and in *S. mitranus* and well over a third in *S. hemprichii*.

SQUAMOSAL BONE. *S. scincus*. In adults, this bone curves gently forwards and upwards to meet the jugal.

S. mitranus. Here, the upper border of the squamosal is much more sharply angled than in *S. scincus*. Where it contacts the supratemporal process of the parietal, the upper border may sometimes turn upwards to form a small spur.

S. hemprichii. In this species, squamosal flexure is even more pronounced and an upward spur bordering the supratemporal process of the parietal is present and better developed than in any *S. mitranus*.

These differences are best marked in adult animals but juveniles also show them to some extent.

SUPRATEMPORAL BONE AND SUPRATEMPORAL PROCESS OF THE PARIETAL. The supratemporal bone is relatively small in the *S. scincus* complex and largest in *S. hemprichii*.

The supratemporal process of the parietal extends roughly to the level of the suture between the supraoccipital and exoccipital bones. In the *S. scincus* complex, its ventral tip is almost level with that of the squamosal, while in *S. mitranus* it is well above this. In *S. hemprichii* the surface exposure of the process becomes acutely narrowed above the level of the upper edge of the squamosal, but continues downwards for some way as a narrow spur, although this is not always visible in lateral view.

Premaxillary rostrum

In *Scincus*, the premaxilla projects forwards as a bony rostrum that supports the spatulate snout tip. The rostral part of the premaxilla is strengthened on each side by a flange arising from the maxilla. The extent of the rostrum is not easy to assess accurately without dissecting the snout, but on the basis of radiographs and a limited number of skull preparations, it appears to vary as follows :

S. scincus complex : rostrum moderately well developed (least so in *S. s. conirostris*).
S. mitranus : rostrum extremely well developed.
S. hemprichii : rostrum poorly developed.

Eyes

The eyes of most *Scincus* have an approximately round pupil and a relatively small cornea (horizontal diameter about 32–39% of total diameter of eye). In *S. hemprichii*, however, the contracted pupil is a vertical slit and the cornea is considerably larger (horizontal diameter about 47–58% of total diameter of eye).

Variations in scaling

Terms used in the literature for particular head scales of *Scincus* have varied. The scale immediately behind the nasals has been called either the first loreal or the postnasal and both internasal and supranasal have been employed for those scales that wholly or partly separate the rostral from the frontonasal. In this account, first loreal and internasal will be used.

Rostral-frontonasal contact. In most cases, the rostral scale contacts the frontonasal, thus separating the two internasals. The width of such contact varies. Contact is absent in *S. hemprichii*, in nearly all *S. s. conirostris* examined and, very rarely, in other populations of the *S. scincus* complex as well.

Prefrontal fusion. Most individuals of *Scincus* have two separate prefrontal scales, fusion usually being rare. However, in northern populations of *S. mitranus*, fusion is by far the commonest condition.

Number of supraocular scales. In nearly all cases, members of the genus *Scincus* have six supraocular scales on each side. Infrequently, two of the scales, usually the second and third, fuse and reduce the supraocular count to five, either unilaterally or on both sides. This is a rare variant in many populations but it is more common in Arabian *S. scincus* : it occurs in 15 out of 28 *S. s. meccensis* and in eight out of 28 *S. s. conirostris*. The number of supraocular scales has been used in defining nominal species of *Scincus*, for instance *S. gasperetti* is distinguished by this feature, but the fact that animals with five or six supraoculars over each eye may occur together in the same populations suggest that this character is not of great importance in itself.

Frontoparietal contact. In most *Scincus*, the frontoparietal scales are nearly always in contact, usually broadly so, but in *S. hemprichii* this contact is reduced or even absent.

Size of parietal scales. The parietal area of the skull in *Scincus* is covered by a series of paired scales bordering the interparietal on each side ; two, three or more pairs are usually involved. Schmidt (1939), in describing his *S. arabicus* (= *S. mitranus*), refers to all these as parietals: 'parietals broken into small transverse scales, three on the left, two on the right'. However, all but the first pair, which is often enlarged, are not easily distinguishable from the paired mid-dorsal scales on the neck and it seems most convenient to refer to all these as 'nuchals' and confine 'parietal' to the first pair, which contacts the frontoparietals.

In the *S. scincus* complex and *S. hemprichii*, the parietal scales are usually conspicuously larger than the contiguous nuchals, but in *S. mitranus* they are relatively small.

LOREALS. Loreal scales exist in three main conditions in *Scincus*: (*a*) three loreals increasing in size posteriorly, the first of which is separated from the frontonasal by contact between the internasal and the second loreal; (*b*) three loreals increasing in size posteriorly, the first of which contacts the frontonasal scale; (*c*) two loreals, the first scale in conditions (*a*) and (*b*) being absent.

Condition (*a*) is widespread. Condition (*b*) occurs as a relatively rare variant in many populations but is the common condition in the *S. scincus* complex in parts of western Africa, etc., in *S. s. meccensis* and in *S. mitranus* from 'Muscat' and Masirah Island. Condition (*c*) is also widespread as a rare variation but is the common condition in northern populations of *S. mitranus*.

DEPTH OF UPPER LABIALS RELATIVE TO LOREALS. If the depth of the third upper labial is compared with that of the penultimate loreal (both depths being taken perpendicular to their common suture) considerable variation is encountered. The labial is only about 1·3 to 2·2 times as deep as the loreal in the *S. scincus* complex whereas it may be 2·3 to 3·0 times as deep in *S. hemprichii*. In *S. mitranus* it is about 1·5 to 2·8 times as deep.

MID-DORSAL SERIES OF SCALES ON TAIL. There are two mid-dorsal series of scales on the base of the tail, but these are replaced by a single, laterally expanded, mid-dorsal series distally. In *S. hemprichii*, this midline series extends far forwards, always well beyond the extremities of the posteriorly adpressed hind limbs. In the *S. scincus* complex, it is often reduced to a few scales on the tail-tip and only occasionally extends to the level of the extremity of the adpressed limbs. In *S. mitranus*, it is variable but tends to be intermediate in extent between *S. hemprichii* and *S. scincus*.

BODY SCALES. Various aspects of body scaling have been used in defining species of *Scincus*. They include the number of scales around the mid-body, the size of the mid-dorsal scales compared with the ventrals, and the presence or absence of longitudinal ridging on the dorsals.

Mid-body counts range from 22 to 31. In most animals, the count is even, but a substantial minority have odd counts (often about 10% of a population, but up to 20% may be involved). Counts vary in the *S. scincus* complex from 24 to 30, in *S. mitranus* from (25) 26 to 30 (31) and in *S. hemprichii* from 22 to 24. In the *S. scincus* complex and *S. mitranus*, there is some geographical variation and this is summarized on pp. 210, 220 and 228.

Actually, the number of scale-rows across the mid-belly is constant at eight, including the row covering the lateroventral ridge on either side. This means that variation in the number of scales around the mid-body is due only to variation in the number of dorsal scales. As might be expected from this, animals that have high mid-body counts tend to have mid-dorsals that are relatively small compared with the mid-ventrals. Thus the largest mid-dorsals occur in *S. hemprichii* and in some western populations of the *S. scincus* complex, both of which have low mid-body counts. These are the only populations to have longitudinal ridging on the dorsal scales. It is confined to adults and in the *S. scincus* complex it is extremely weak.

Size and shape of head

SIZE OF HEAD. Head proportions are not easy to measure accurately in intact specimens of *Scincus*. The back of the skull is usually well covered by soft tissue, and this, together with the often thick osteodermal layer of the skin, makes the precise location of reference points very difficult. However, some idea of the relative differences in head proportion can be conveyed by making approximate measurements.

In all forms, relative head length at first falls steadily with growth, but in larger animals this trend sometimes reverses and the head begins to increase in relative length. Such increase is much more pronounced in males, as these grow considerably larger than females. It is very marked in *S. hemprichii* but scarcely apparent in *S. mitranus*. The *S. scincus* complex is rather variable, increase in head size being marked in *S. s. conirostris* but weaker in other populations. As might be expected from this, relative head lengths of adults are least in *S. mitranus* (19–24% of snout to vent length, in animals over 80 mm), greatest in *S. hemprichii* (24–30% in animals over 80 mm), and intermediate in the *S. scincus* complex (about 21–26%).

Head width may increase relative to head length. This is most apparent in *S. mitranus, S. s. conirostris* and *S. hemprichii*. As the last two forms are relatively large-headed, this results in their having heads conspicuously wider than the body.

SHAPE OF SNOUT. Snout shape is distinctive in some forms although there is often considerable variation within taxa (for instance, as Mertens, 1972, notes for west African members of the *S. scincus* complex – under the name *S. albifasciatus*). In *S. hemprichii* the snout is very broad with no obvious *canthi rostrales*, and in profile from above the sides are straight or slightly convex. In other forms the snout is narrower, canthi are well developed and the sides are often slightly concave. The snout tends to be rather short in *S. s. conirostris* and overhang of the lower jaw by the rostral is least in this form and in *S. hemprichii*.

Colouring

DORSAL PATTERN OF YOUNG. With the exception of *S. hemprichii*, populations of *Scincus* have young with a fine, homogeneous dorsal pattern and no bold markings. Usually, the ground colour is some pale shade of buff, grey, brown or cinnamon. This may be virtually uniform, or the scales may have darker edges, or they may be dappled with light and dark markings, which are sometimes confined to the scale-edge (there often being one or two small, dark, spots bordered by light pigment), or may involve a much greater area of the scale.

S. hemprichii is peculiar in that its young have a bold dorsal pattern. Most scales are brownish, with a dark edge, but these are interspersed by transverse bands of light-edged scales.

Dorsal pattern of adults. Adult animals may retain the juvenile pattern without much change (at least as discernible in spirit material), apart from some modification in contrast. For example, in *S. hemprichii*, there may be some fading, especially of the dark scale-edges. A fine homogeneous pattern is retained by *S. mitranus*, some *S. scincus conirostris*, some *S. s. meccensis* and some members of the *S. scincus* complex from North Africa (animals assigned to *S. s. laterimaculaus*, and many females of populations usually assigned to *S. s. cucullatus*). In other members of the *Scincus scincus* complex, the juvenile colouring differentiates to produce a bold pattern visible in spirit material. Differentiation involves either the spread of dark pigment in restricted areas of the dorsum or loss of dark pigment to form partly translucent areas that are often brightly coloured in life, or both. In all cases, the pattern so produced consists of often irregular transverse bands. In North Africa, with the exceptions listed above, dark transverse bands are prominent in the pattern.

Bars on flanks. In many populations of *Scincus*, adults have prominent vertical bars or spots on the flanks. These do not disappear in alcohol and vary in colour from pink, through red and maroon, to a deep warm, blackish-brown. They are absent in the young and develop first on the foreparts. Flank bars usually occur in *S. mitranus*, *S. s. meccensis* and in the African populations of the *S. scincus* complex to which the names *albifasciatus* and *laterimaculatus* are often assigned.

Tail pattern. In most *Scincus*, the fine, dappled pattern on the body becomes weaker on the dorsum of the tail, but in some northwest African populations (usually assigned to *S. s. laterimaculatus*) it may become more pronounced in adults.

SYSTEMATIC ANALYSIS

Of the characters listed in the previous section, those involving the ear and associated parts of the skull are very stable within populations. This character complex exists in three clearly separable states and, as these often correlate with some other morphological features, it seems certain that they indicate systematic entities. Two of these are very clearly defined species, *S. mitranus* and *S. hemprichii*, both confined to Arabia. The third covers virtually the whole range of the genus and may consist of more than one species, so it will be referred to as the *S. scincus* complex.

North Africa and Israel

All the *Scincus* of this area belong to the *S. scincus* complex and are very similar in general morphology, although there is considerable local variation in colouring and some features of scaling. As will be shown, there is at least one area where populations exhibiting consistent differences may possibly come into contact; this is discussed further on p. 215.

Arabia, Jordan, Iraq and Iran

Northwestern Arabia and nearby southern Jordan are occupied by a form generally similar to *S. scincus s. str.* of Egypt and Israel, with which it should be regarded as conspecific. All its characteristic features are found in one or other of the populations that constitute the North African *S. scincus* complex, but it differs from the nearest ones in the following features : adults lack dark transverse bands on the back, dark bars or spots are present on the flanks of adults, the first loreal almost always contacts the frontonasal and the supraoculars are often reduced from six to five on each side. It seems reasonable to treat this form as a distinct subspecies, *S. scincus meccensis*. The range of this taxon approaches closest to Israeli and Egyptian populations of *Scincus* in the region of Wadi Araba, which joins the Gulf of Aqaba to the Dead Sea. This wadi often separates the ranges of related reptiles that are distinct at the species or subspecies level (Werner, 1971).

In parts of southern and eastern Arabia, Iraq and southwestern Iran, another form generally similar to *S. scincus* occurs. This differs from neighbouring *S. s. meccensis* in lacking dark bars or spots on the flanks, in having the frontonasal separated from both the rostral and the first loreal and in possessing a wider head, at least in adult males. There is no evidence that this form is sympatric with *S. s. meccensis* (although it must be remembered that relatively few *S. scincus*-like skinks have been collected in Arabia to date), so it is regarded here as a further subspecies, *S. s. conirostris*.

In southern and eastern Arabia, another form is found, for which the oldest name is *S. mitranus*. There is no doubt that it is specifically distinct from *S. scincus*, for it coexists with *S. s. conirostris* at several localities (Kuwait, Abqaiq, Dhahran, eastern United Arab Emirates, Hadhramaut) and differs from this form in many features. Apart from those characters set out in Table 5 (p. 240) that distinguish the *S. scincus* complex as a whole from *S. mitranus*, the latter differs from the sympatric *S. s. conirostris* in having the rostral scale in broad contact with the frontonasal, a broader snout-tip, a relatively smaller head, at least in adult males, and dark bars or spots on the flanks of mature animals.

The extreme southwest of the Arabian peninsula is occupied by a single form of *Scincus*, *S. hemprichii*. It appears to be separated from *S. mitranus* and *S. s. conirostris* by mountainous country unsuitable for *Scincus*, and there is a gap of over 500 km between its northernmost locality on the coast and the nearest known populations of *S. s. meccensis*. This hiatus contains geographical features that may be important in isolating the two forms from each other (see p. 242). However, although it may well be completely allopatric, *S. hemprichii* has so many distinctive features that it must be regarded as a fully differentiated species (see Table 5, p. 240).

SCINCUS Laurenti

Scincus Laurenti, 1768 : 55.
Pedorychus Wiegmann, 1837 : 128.
Scincus (*Arenatius*) listed by Haas & Battersby, (1959) without comment is a *lapsus calami* for *S. arenarius* and was not intended as a subgenus.

TYPE SPECIES. *Lacerta stincus* (*lapsus calami* for *scincus*) Linnaeus, 1758.

Diagnosis. A genus of skinks with a full scincomorph complement of skull bones. Palatines and pterygoids widely separated on the midline of the palate, premaxilla single, postorbital and postfrontal bone fused, nostril situated largely or completely between two nasal scales. Limbs well developed. Numerous features associated with life in loose sand present : a wedge-shaped head with spatulate, overhanging snout supported by a premaxillary rostrum ; countersunk jaw ; angular upper labial scales ; valvular, often crescentic nostrils ; small ear orifices with long meatus ; ⌓-shaped body section ; powerful body musculature ; and depressed, fringed digits. Dorsum uniform, with fine dappled pattern or with transverse bands. Adult males considerably larger than adult females.

Habitus. Rather robust, with poorly defined neck and well-developed limbs. Head wedge-shaped in lateral view and, seen from above, tapers forward from broad, temporal region. Snout spatulate, overlapping the lower jaw anteriorly and at the sides, its tip forming a sharp, horizontal edge. Upper labials very strongly angled in cross-section, the ridge so formed being continuous with the sharp edge of the snout-tip. Front of the lower jaw is countersunk, so that the underside of head is almost flat. Canthus rostralis usually present, although not always very distinct. Eyes relatively small. Ear apertures small, or very small, their upper border situated just above, on, or below a continuation of the line made by the lower edges of the upper labial scales. Neck and body ⌓-shaped in cross-section, producing a lateroventral ridge on each side that runs from beneath the jaw to the groin. Tail relatively short, usually less than 80% of snout to vent distance, a tapering cylinder that may be laterally expanded proximally and is often rather compressed distally. Forelimb extends forwards to about level of eye. When fore- and hind-limbs adpressed, fingers and toes overlap. Digits dorsoventrally compressed.

Scaling. Rostral broad, spatulate and sharp-edged, often bordering the approximately hexagonal or pentagonal frontonasal, but sometimes separated from it by midline contact of the internasals. Paired prefrontals usually meet, but are occasionally fused (very frequently so in northern populations of *S. mitranus*) or, more rarely, separated by a small azygos scale. Frontal wider in front than behind, often markedly so. Frontoparietals typically in broad contact (but contact limited or even absent in many *S. hemprichii* and in occasional specimens of other forms). Interparietal large, more or less lozenge-shaped, with a clearly defined parietal 'eye' ; it separates the typically quadrangular parietals, which are usually larger than the contiguous nuchals (sometimes subequal in *S. mitranus*). Usually six supraoculars (second and third sometimes fused). Supraciliaries typically four on each side, but number may vary from two to five.

Nostril oval or crescentic, situated just above the sharp ridge formed by the rostral and upper labials, placed between an upper and lower nasal scale and sometimes also making narrow contact with the rostral anteriorly. Usually three loreals that increase in size posteriorly : first may reach frontonasal, but separated from it, in majority of cases, by contact between internasal and second loreal. First loreal sometimes absent or fused with second. Upper labials usually eight on each side (but number varies from seven to nine), typically very deep posteriorly where they may project well below tips of maxillary teeth. The anterior upper labials are strongly angled, to form a sharp ridge continuous with that of the rostral. A single row of sub- and postoculars borders eye. Lower eyelid covered by translucent scales, some of them large. Temporal formula : 1+2.

Mental single. Typically eight lower labials on each side and two azygos postmentals followed by about three pairs of large scales, each pair usually being divided on the midline by a smaller scale.

Small ear aperture often protected by two (rarely three) overlapping, denticulated scales, or by a single, large, often smooth-edged scale.

Laterally expanded nuchal scales up to about twice the width of neighbouring scales ; typically four or five pairs present, but number may vary from nil to ten on each side. Scales on rest of neck and on body cycloid, either all smooth or dorsals with two or three weak ridges.

Mid-dorsals about as large as mid-ventrals, although often slightly bigger or smaller. 22 to 30 (31) scale rows round mid-body, of which eight cover the belly, including the lateroventral ridges. Even mid-body counts are commonest, but odd ones do occur (often in about 10% of a population). Vent covered by two large, flat shields and bordering it on each side of the tail-base is a small, raised, often sharp-edged scale. Scales on tail mainly cycloid, but central row on underside is laterally expanded. A less expanded row exists on the mid-dorsal line, but is confined to the more distal parts of the tail and is sometimes restricted to the tip.

Scales on limbs cycloid and regular. Digits dorsoventrally flattened and covered by an upper and a lower row of lamellae. On most digits, the upper row projects posteriorly and the lower anteriorly, to produce fringes of pointed lamella tips, but on the fifth toe of each forelimb, the upper row projects anteriorly and the lower posteriorly. On all toes the posterior fringes are better developed than the anterior ones. Ungual lamellae strongly expanded ; claws flattened and hollowed beneath.

COLOUR AND PATTERN. In one species (*S. hemprichii*), adults and young are brown above with narrow, light, transverse bands. Other species have young that are uniform (ivory, cream, grey, buff, warm brown or cinnamon) or finely dappled with small, light and dark markings. This homogeneous pattern may be retained and often matches the sand in which the animal lives. In other cases, the fine, dappled pattern becomes overlaid by a series of sometimes irregular, transverse bands, either dark or light, or both. There is considerable variation in the number, extent and intensity of these bands ; they may be narrow or broad and do not always extend right across the body. Flanks of adults may bear a series of usually dark, vertical bars or spots that often diminish in size posteriorly and alternate with the dark, dorsal bands, where present.

Often a rather obscure, dark bar in the area of the canthus rostralis, which may continue backwards onto the cheek and neck and is sometimes strongly developed. Dorsum of tail may be more, or less, heavily marked with dark pigment than back, or, distally may be contrastingly coloured bluish or reddish, especially in young.

Underside uniformly pale ; white, cream or greyish. In life, many animals have some yellow or pale orange pigment, especially on feet and flanks and often in the dorsal area as well. This disappears in spirit.

Iris dark brown or blackish in life ; tongue apparently always pink.

EYE. Usually 14 scleral ossicles. Cornea about 30–60% of horizontal diameter of eye. Pupil more or less round or vertical, when contracted.

EAR (Figs 1–3). External auditory meatus long or very long, sloping downwards and forwards. Distal section usually with at least some traces of scaling, proximal section membranous with a triangular cartilage in its outer wall. Extracolumella varies in form from a relatively slender bar to a large, irregular plate. Stapes slender or relatively robust.

HEMIPENIS. Symmetrically and shallowly bilobed, with at least some plication on the lobes.

SKELETON. *Skull.* Full scincomorph complement of skull bones present. Premaxilla single with three or four teeth, projecting forward to form a bony rostrum that receives support on each side from a maxillary flange. Paired nasal bones extend anteriorly only as relatively narrow spurs on each side of the posterior process of the premaxilla. Nasal cavity uncovered anteriorly and front of septomaxilla clearly visible from above. Frontals paired, each contacting a maxilla anteriorly, thus separating nasal and prefrontal bones. Lateral processes of frontal not well developed. Parietal single with well-defined central foramen, its lateral descending processes long and finger-like.

Supratemporal process of parietal may extend almost to level of ventral tip of squamosal, or not. Supratemporal bone variable in size.

Postorbital and postfrontal bones fused even in young animals, not extending backwards to cover the posterior part of the supratemporal fossa. Squamosal varies in shape and runs forward to contact jugal. Maxillae with pleurodont, simple teeth, about 15–20 in adults, but counts are lower in juveniles.

Vomers separate, but in contact on midline, rather elongate. Palatines closely opposed (although not touching) above air passage, widely separated on palate, not usually contacting ectopterygoids along posterior edge of suborbital foramen (Greer, 1970, states that they do so in material of *S. scincus* examined by him.) Pterygoids with teeth. Otic capsule normal, or strongly expanded. Osteodermal layer covers most of upper surface of skull and the supraorbital areas.

Mandible. Meckel's groove open. No fusion between the main elements. About 13–20 teeth present in adults, but counts are lower in juveniles.

Postcranial skeleton. Usually 27 procoelous presacral vertebrae (rarely 26 or 28), with rather long neural spines that are expanded sagittally. Eight cervical vertebrae, of which numbers one to five have long hypopophyses and numbers four to eight bear ribs (first three short and flattened, last two long and cylindrical). All other presacral vertebrae bear dorsal ribs, the last four to six being shorter than the rest, although the reduction in length is not very abrupt.

Three sternal ribs and two xiphisternal ribs present. Sternum lozenge-shaped, nearly always without a central fontanelle. Xiphisternal cartilages arise close together, diverge to the origin of the first pair of xiphisternal ribs and then converge to join at the origin of the second pair. A single pair of inscriptional ribs may occur immediately posterior to the xiphisternum. It is present and attached to the dorsal ribs in *S. hemprichii*, whereas in *S. mitranus* it usually forms a free chevron on the midline and is sometimes absent. In the *S. scincus* complex, it may be attached, free or lacking. Clavicle laminar, either expanded throughout its length or, more usually, expansions confined to the region of contact with the lateral arm of the interclavicle and to the medial extremity, where it is fenestrated. The posterior margin may be very irregular with one or more projections. Interclavicle cruciform, the lateral arms being almost at right angles to the longitudinal axis or, more frequently, clearly directed forwards.

Hyoid apparatus consists of glossohyal, hypohyal and ceratohyal, first ceratobranchial and a short second ceratobranchial.

OSTEODERMS. These have the usual scincid pattern of canals (see, e.g., Greer, 1970).

SIZE. Adult males considerably larger than females. Largest about 140 mm snout to vent, but males in some populations not much exceeding 120 mm. Females on average about 75–85% length of males. Smallest hatchlings are about 38 mm snout to vent.

DISTRIBUTION. Sahara and neighbouring areas eastwards to east Arabia and southwest Iran. Northward limit runs south of Atlas Mountains, along the coast of Tunisia, Libya and Egypt, through southern Israel, southern Jordan, central Iraq and southwest Iran. Southernmost parts of distribution include Senegal, Mali, Niger, northwest Nigeria, southeast Libya, central Egypt and southern Arabia. May possibly occur in Eritrea (p. 235) and has been erroneously stated to be found in Pakistan (p. 229).

SPECIES REFERRED. *S. hemprichii*, *S. mitranus*, *S. scincus*, complex (which may possibly include two largely allopatric species, *S. scincus* and *S. albifasciatus*).

KEY TO *Scincus*

a. Ear opening clearly visible and relatively large, its upper border reaching the backward continuation of the line made by the lower edges of the upper labial scales. External meatus relatively short, meatal cartilage short, extracolumella a slender bar, squamosal gently curved, otic capsule normal . . . . ***S. scincus*** complex

b. Ear opening very small but usually visible, nearly always situated well below the line made by the lower edges of the upper labial scales. Dorsum more or less uniform. Vertical bars or spots usually present on flanks of adults and rostral in broad contact with frontonasal scale (neither character apparently found in sympatric populations of ***S. scincus***). External meatus very long, meatal cartilage long, extracolumella expanded, squamosal angled, otic capsule normal. South, central and eastern Arabia only . . . . ***S. mitranus***

c. Ear opening minute, not visible externally. Dorsum usually with light, transverse bands. Vertical bars or spots absent from flanks and rostral separated from frontonasal scale. External meatus long, meatal cartilage short, extracolumella greatly expanded, squamosal angled, otic capsule huge. Extreme southwest Arabia only ***S. hemprichii***

The *Scincus scincus* complex

Lacerta stincus (*lapsus calami* for *scincus*) Linnaeus, 1758 : 205. Type locality : 'in montosis Lybiae, Aegypti, Arabia petreae'. Location of type : Naturhistoriska Riksmuseet, Stockholm (Registered number : 141a).

Scincus officinalis Laurenti 1768 : 55 (nomen substitutum).

For other names applied to *S. scincus*, see discussion of geographical variation and subspecies (p. 209 et seq.).

DIAGNOSIS. Head variable in size but tending to be intermediate between that of *S. mitranus* and *S. hemprichii* ; external ear orifice relatively large, its upper margin reaching the continuation of the line made by the lower edges of the upper labial scales and typically covered by two serrated scales. Eye with relatively small cornea and rounded pupil. Rostral scale usually borders frontonasal, at least narrowly (but not in *S. s. conirostris*, or in rare examples of other populations) ; frontoparietals in usually extensive contact ; parietals relatively large (usually 1·5 to 2·5 times length of adjoining nuchals). Dorsal scales usually smooth, but very weakly ridged in some adults, mid-dorsals subequal to mid-ventrals, but sometimes distinctly larger, or slightly smaller. 24 to 30 scales around mid-body. Young either almost uniform or with fine, dappled pattern ; this may be retained by adults or converted into a system of dark or light transverse bands, or both ; dark bars or spots may be present on the flanks of adults in some populations.

Auditory meatus comparatively short ; its distal section thick-walled and lined with well-developed scales ; cartilage in lateral wall short. Extrastapes a slender bar. Premaxillary rostrum moderately developed. Squamosal gently curved, no spur on its upper border. Distal section of supratemporal process of parietal not constricted, terminating almost at level of ventral tip of squamosal.

EXTERNAL FEATURES. Head rather variable in size, often a little narrower than, or as broad as, the neck and as the body at level of forelimbs, but considerably broader in mature males from Egypt and in male *S. s. conirostris* ; length in animals over 80 mm varies from about 21 to 26% of snout to vent distance, width is from about 52 to 70% of head length. Top of head may rise gently in lateral profile, as in *S. mitranus*, or more steeply and sometimes as much as in *S. hemprichii*. Canthus rostralis quite well marked ; loreal region distinctly concave. Tail broader than deep proximally, laterally compressed – at least to some extent – distally. Up to 80% of snout to vent distance when undamaged.

Rostral overhangs mental strongly, sometimes as much as in *S. mitranus*, least in some *S. s. conirostris* ; in contact with frontonasal in most cases but not in nearly all *S. s. conirostris* and rare individuals from other populations ; if present, such contact is variable in extent, but may be as great as in *S. mitranus*. Prefrontals in contact (rarely fused, or separated by an azygos shield). Frontal broader in front than behind. Frontoparietals usually in broad contact (but occasionally this is rather restricted). Parietals relatively large, typically 1½ to 2½ times the length of adjoining nuchals but sometimes three times as long. Supraoculars usually 6 : 6, but five supraoculars, either uni- or bi-laterally, occurs as a rare variant in North Africa and more commonly in Arabian populations. Supraciliaries usually four on each side, but number varies from three to five.

Nostril laterally oval, or crescentic; rostral completely excluded from its border in the great majority of cases. Three (very rarely two) loreal scales on each side; first loreal does not contact frontonasal in nearly all individuals of many populations, but reaches frontonasal in majority of animals from western North Africa etc. and from northwest Arabia etc. Upper labials rather variable in depth when compared with second loreal, usually 1·3 to 2·2 times as deep; typically eight on each side, but number varies from seven to nine. Ear orifice relatively large, its upper margin situated slightly above, or level with, a continuation of the line made by the lower edges of the upper labials; covered by two (occasionally three) scales, the posterior edges of which are strongly serrated to produce a fringe, often with four main lobes.

Typically three to five pairs of nuchal scales, but number on one side may vary from one to ten. Dorsal scales usually smooth but may be very slightly ridged, at least posteriorly, in some individuals from the extreme west of the range (Spanish Sahara to Senegal); mid-dorsals often subequal to mid-ventrals but they may be rather wider in western animals. 24 to 30 scales around mid-body. Row of laterally expanded scales on dorsal midline of tail usually quite poorly developed, and in great majority of cases does not extend to the level of the extremities of the posteriorly adpressed hindlimbs, and only very rarely beyond.

The parts of the lamellae forming digital fringes are somewhat variable being sometimes quite broad and sometimes mucronate. Claws long, and, like ungual lamellae, often expanded laterally.

COLOUR AND PATTERN. Dorsum of young animals uniform, or with a dappling of small dark or light spots, or both. Ground colour varies and may be ivory, pale grey, straw, pale buff, pale brown or cinnamon. The dappled pattern typically consists of one or two dark spots per scale, sometimes confined to the posterior edge, where they may coalesce to form a dark border; they are typically edged and separated by pale pigment. These elements may sometimes extend forward to cover much of the scale. A simple dappled dorsal pattern is retained by some animals (e.g. northwest Algerian populations and some animals in Arabia) but it often differentiates with maturity to produce a series of dark or light transverse bands or both. Dark bands produced by spreading of the dark pigment are found in many North African populations and vary considerably in width and number. They may be much wider than the lighter interspaces or much narrower and they vary in intensity. From the forelimbs to the vent, there may be five to ten bands; a further band is present on the posterior neck and this may or may not fuse with an anterior nuchal patch that is usually visible. The dark transverse bands often anastomose and are sometimes staggered on each side of the body. When poorly developed, they may be most prominent in the dorsolateral region. Light bands visible in spirit are produced most usually by loss of pigment from the scales and in life are often yellow or deep orange. In North Africa they may alternate with the dark bands, but in Arabia this is not so and they are often confined to the dorsolateral region. Dappled pattern is often reduced on the tail but is intensified in northwest Algerian animals. Flanks and limbs tend to be paler than the back and there may be some dark (often greyish) pigment along the sides of the head and neck: this is very marked in northwest Algerian animals where there is a distinct dark streak on each side.

In life, most animals have some yellow or orange pigment. Apart from in the light transverse dorsal bands, when present, there is often a suffusion of yellow on the feet, limbs and flanks.

Adults in some populations (western North Africa etc., northwest Arabia) have a row of spots or short vertical bars on the flanks that vary from pale pink through red to a very deep purple brown. They alternate with the dark dorsal bands, if any, and begin in front of the forelimbs and may extend to the tail-base, although they tend to diminish in size and intensity posteriorly. There is considerable local and individual variation in their form, colour and arrangement. Typically there is one in front of the forelimbs and from three to six between the two pairs of legs. These markings are absent in hatchlings but may develop in animals as small as 62 mm.

Underside whitish or cream. Iris very dark brown or blackish.

EYE. Cornea relatively small, about 32–40% ($n = 6$) of horizontal diameter of eye. Pupil rounded ; not a vertical slit when contracted.

EAR (Fig. 1). Meatus relatively short, distal section quite thick-walled and lined with scales. Cartilage in upper portion short and triangular. Tympanum relatively large (compared with skull length). Distal section of extrastapes forms a slender bar. Stapes slender, foot-plate small.

SKULL (Fig. 1). Premaxillary rostrum rather variable but better developed than in *S. hemprichii* and less so than in *S. mitranus*. Squamosal gently curved, no upward spur bordering supratemporal process of parietal. The latter is not constricted ventrally and terminates at, or just above the level of, the ventral tip of the squamosal. Supratemporal bone comparatively small. Otic capsule relatively small (in animals with a skull length of 20 mm, it is about a quarter of that length) ; in lateral view its posterior border is not, or only slightly, visible behind the supratemporal bone and supratemporal process of the parietal. Maxillary teeth 16–20 in large adults ; mandibular teeth about 15–20.

SIZE. Some geographical variation in maximum size. Largest animals are from northwest Algerian Sahara (populations known as *S. s. laterimaculatus*) where males may attain 140 mm (Werner, 1914). In other areas animals are smaller and in Egypt and Arabia males do not exceed 120 mm. Females are about 80–85% snout to vent length of males. See Tables 1–3 and subspecies texts for details of variation. Smallest juveniles are about 40 mm snout to vent and animals up to at least 50 mm may have a visible umbilical scar.

DISTRIBUTION (Figs 5 and 6). Widespread in the Sahara Desert and neighbouring areas eastwards to southwest Iran and southeast Arabia. Northern border runs south of Atlas Mountains, along the Mediterranean coast of Tunisia, Libya and Egypt, through southern Israel, southern Jordan, central Iraq to southwest Iran (Khuzistan and Gulf Coast). Southern border (so far as it is known, runs from Senegal (Dakar area), through Mali (Timbouctou ; Adrar des Iforas – fide Angel & Lhote, 1938), northwest Nigeria (Sokoto), Niger (Air ; Bilma – fide Angel & Lhote, 1938), southeast Libya (Kufra), central Egypt (Dakhla), north Sinai to southern Arabia, but not extreme southwest, southernmost records being Democratic Republic of Yemen (Hadhramaut) and eastern United Arab Emirates (Ra's al Khaymah etc).

GEOGRAPHICAL VARIATION. Considerable geographical variation exists in the *S. scincus* complex. East of the Red Sea there are two populations that differ quite consistently in some aspects of colouring, scaling and proportion and these are recognized here as subspecies : *S. s. meccensis* (p. 219) and *S. s. conirostris* (p. 221). The situation in North Africa is less clear and is discussed below.

NORTH AFRICAN POPULATIONS OF THE *Scincus scincus* COMPLEX

Most of the characters known to vary geographically are displayed in Table 1. The position of the numbered localities can be found under MATERIAL EXAMINED and in Fig. 5, which also shows the known distribution of pattern types. Numbers of dark, transverse bands on the dorsum include the one situated between the forelimbs and all others as far as the vent region, but not bands on the neck.

Israel

Locality : 51.
Sample size : 1.
Main features. This single specimen, which is a male, is generally very similar to Egyptian material.

North and central Egypt

Applicable name. *S. s. scincus* (Linnaeus).
Synonyms. *Lacerta* (*Edda*) Donndorf, 1798 : 134. Type locality : 'in Abyssinia'. Location of type : not traced.
Scincus officinalis var. *lineolata* Werner, 1914 : 343. Type locality : Cairo. Location of type : Naturhistorisches Museum, Vienna (Registered number : NMW 10390 : 11).
Localities : 42 to 48, 50.
Sample size : 46.
Main features. Relatively small maximum body-size ; mature males often broad-headed (head distinctly broader than neck). Typically 26 scales around mid-body, or less ; frontonasal nearly always separated from first loreal. Dorsal colouring consists of relatively numerous (usually eight or nine from forelimbs to vent), dark, transverse bands that are about the same width as the interspaces, or a little broader or narrower ; posterior neck band often separated from nuchal patch ; no sexual dimorphism. Banding may develop at 76 mm snout to vent (largest animals without bands are 78 mm). No dark bars on flanks.

Dakhla Oasis and 'Libyan Desert'

Locality : 49.
Sample size : 4.
Main features. Generally like other Egyptian material, but 28 or 30 scale-rows at mid-body and transverse bands may be slightly narrower.

TABLE 1

Variation in North African populations of the *Scincus scincus* complex

Region	A	B	C	D	E	F	G	H
Sample size	47	4	6	72	32	28	65	5
Mid-body scale count								
24	2				1		20	
25	1						7	
26	40		2	9	25	10	36	2
27				5	2			
28		3	4	41	4	15		3
29				7				
30		1		8		1		
Specimens in which frontonasal contacts first loreal :								
both sides	2			6	11	4	59	
one side	2		1	3	6		4	
Dark transverse bands on back : width relative to interspaces	about equal or a little narrower or wider	slightly narrower	narrower	much narrower (often absent in females)	subequal	none	often much wider, sometimes subequal	much narrower

Dark transverse bands on back: number from forelimbs to vent region								
5							5	
6				12			20	1
7	1		3	19	1		8	1
8	17	3	2	3	12			3
9	8				8			
Posterior neck band separated from nuchal patch	often	yes	often	no	no	absent	no	no
Dark bars on flanks of adults	no	no	no	no	no	yes	yes	no
Size of largest individuals (mm)								
males	119, 114, 112, 112, 111	115	—	128, 122, 121, 117, 116	106, 104, 88	139, 136, 134, 133, 132	129, 120, 118, 111, 111	97, 95, 90
females	98, 94, 92, 91, 90	—	105, 104, 92	104, 102, 101, 99, 97	107, 98, 97, 87, 83	115, 114, 112, 112, 100	98, 98, 96, 95, 95	86
Remarks	head broad in mature males					head always narrow		

Regions – A: north and central Egypt, Israel (localities 42 to 48, 50, 51). B: Dakhla Oasis and 'Libyan Desert' (locality 49). C: northeast Libya (locality 40). D: northwest Libya, Tunisia and northeastern Algeria (localities 21 to 29, 31 to 39). E: southeast Algeria (localities 30, 30a). F: Northwest Algeria (localities 17 to 20). G: Rio de Oro, Mauretania, Mali, Senegal and southeast Libya (localities 1 to 12, 13, 16). H: Nigeria (locality 15).

Northeastern Libya

Locality : 40.
Sample size : 6.
Main features. Similar to Egyptian material, but often 28 scale-rows at mid-body, transverse bands tend to be narrower and fewer, seven or eight being present between the forelimbs and the vent region.

Northwestern Libya, Tunisia and northeastern Algeria

Applicable name. *S. s. cucullatus* Werner.

Scincus officinalis var. *cucullata* Werner, 1914 : 343. Type locality : Tripolis. Location of type : Naturhistorisches Museum, Vienna (Registered number : NMW 10386 : 3).

Localities : 21 to 29, 31 to 39.
Sample size : 72.
Main features. Moderate maximum body size, but some populations may be small. Most commonly 28 scales around body (range 26–30) ; frontonasal usually separated from first loreal. Dorsal colouring of most males and a few females consists of relatively few (usually six or seven from forelimbs to vent region) transverse bands that are much narrower than the interspaces ; posterior neck band is always fused with nuchal patch. Many females and some males are without bands (of animals 70–90 mm snout to vent, three out of five males are banded and three out of twelve females ; of animals over 90 mm snout to vent, 26 out of 26 males are banded and three out of eleven females). Banding may develop at 77 mm snout to vent. No dark bars present on flanks. See also p. 215.

Southeast Algeria (Djanet, Hoggar)

Locality : 30, 30a.
Sample size : 32.
Main features. These animals are generally like north and central Egyptian material, although contact between the frontonasal and first loreal scales is more frequent and mature males do not appear to be very broad-headed. The single example from Hoggar (30a) has fewer, narrower transverse bars than the others and is consequently more like northwest Algerian material.

Northwest Algeria

Applicable name. *S. s. laterimaculatus* Werner.

Scincus officinalis var. *laterimaculata* Werner, 1914 : 343. Type locality : Ain Sefra, western Algeria. Location of type : Naturhistorisches Museum, Vienna (Registered number : NMW 10377 : 4).

Localities : 17 to 20.
Sample size : 28.
Main features. Large maximum body-size : even mature animals have relatively small, narrow heads. Scales round mid-body usually 26 or 28 (rarely 30),

frontonasal usually separated from anterior loreal. No sexual dimorphism in pattern. Adults lack dorsal transverse banding and a dark nuchal patch, but head and neck often bear a strong dark dorsolateral stripe on each side and the dorsum of the tail may be speckled with dark pigment. Vertical bars or spots are present on the flanks of adults.

A sample from Erg er Raoui (locality 18), west of Beni Abbès, consists of small individuals (largest of four is only 95 mm snout to vent, although they may be immature) with contact between the frontonasal and the anterior loreal and very large flank spots.

Rio de Oro, Mauretania, Senegal, Mali (Timbouctou), Niger (Air) and southeast Libya (Cufra)

Applicable name. *S. s. albifasciatus* Boulenger.

Scincus albifasciatus Boulenger, 1890 : 85. Type locality : Dakar. Location of type : British Museum (Natural History), London (Registered number : BM 89.10.18.1/1946.8.13.60).

Boulenger states that, in the holotype, the scales covering the ear opening are unfringed. This is not natural ; the lizard was apparently preserved some considerable time after death and has lost many of its more delicate extremities, including most of the digits.

Localities : 1 to 13, 41.

Sample size : 65.

Main features. Moderate maximum body-size. 24 to 26 scales around mid-body (24 commonest in coastal areas of Mauretania and Senegal) ; frontonasal usually in contact with first loreal. Dorsal colouring of adults consists of relatively few (usually five to seven from forelimbs to vent), dark, transverse bands that are often much wider than the interspaces, although sometimes about the same width ; posterior neck band fused with nuchal patch ; no sexual dimorphism in colouring. Faint banding may develop in animals as small as 62 mm snout to vent. Vertical bars present on flanks of adults (and sometimes in individuals as small as 60 mm snout to vent).

A sample from Chinguetti (locality 5) contains two animals patterned in the way described above and others of similar size that are almost uniform above, with only faint cross-bars or none at all. The two phases were collected on different dates, so it is possible that they did not come from precisely the same collecting site. The virtually unpatterned animals have at least a superficial resemblance to northwestern Algerian individuals, especially those from Erg er Raoui. Pasteur & Bons (1960) describe an apparently similar population from Taouz, southeast Morocco (locality 16), that also contains both banded and unbanded individuals with dark bars on the flanks.

Northwestern Nigeria

Locality : 15.

Sample size : 5.

Main features. Apparently small (largest is only 95 mm snout to vent, but might be immature). 26 or 28 scales round mid-body ; frontonasal separated from first loreal scale. Dorsal pattern consists of relatively few (six to eight from forelimbs to vent area), dark, transverse bands that are much narrower than interspaces ; posterior neck band fused with nuchal patch ; no sexual dimorphism in colouring. No dark bars or spots present on flanks.

Interpretation of the *Scincus scincus* complex in North Africa

At present, it is difficult to decide how to treat the North African specimens of the *S. scincus* complex. There are four comparatively well-investigated peripheral areas, in each of which the *Scincus* population has been named. These are : Egypt and nearby areas (*S. s. scincus*) ; northwestern Libya, Tunisia and northeastern Algeria (*S. s. cucullatus*) ; northwestern Algeria (*S. s. laterimaculatus*) ; Spanish Sahara, Mauritania and Senegal (*S.* (*s.*) *albifasciatus*). In all these regions, the *Scincus* are relatively uniform and show differences from those in the others, but these areas cover only a fraction of the apparent range of the *S. scincus* complex in North Africa. The more central parts of the Sahara and its southern borders include many sandy regions apparently suitable for *Scincus*, yet only a few scattered specimens are available from this vast and undercollected area. Thus, any decisions about the systematic treatment of the complex must inevitably rest on an unsatisfactory sample base. Certainly, a simple division into four subspecies is not tenable, for the *Scincus* available from the poorly known central area do not necessarily closely resemble those from the nearest well-investigated peripheral region. For instance, southeast Algerian *Scincus* from Djanet (locality 30) are superficially more like Egyptian animals than those from northern Algeria, and Nigerian specimens look more similar to examples from northeastern Algeria, Tunisia and northwestern Libya than to intervening populations.

The loose sand habitat, to which *Scincus* is more or less confined, is widespread in North Africa, but it is by no means continuous and dune areas are often separated by substrates unsuitable for *Scincus* thus producing an intricate system of at least partial isolates. Mobile dunes travelling across unsuitable areas in the direction of the prevailing strong winds could act as propagators of gene flow between some otherwise isolated *Scincus* populations, but the pattern of connexion between sandy areas and its extent have undoubtedly varied through time, so at least some geographical units of the *S. scincus* complex have probably been subjected to a complicated sequence of contact and separation. In such circumstances, it might be expected that the degree of differentiation between populations would vary greatly, depending on their length of separation and differences in the selective for cesacting in the areas concerned. Such a situation would be difficult to reflect adequately by delineating subspecies and there is the additional problem that some of the populations may have differentiated enough to act as good species. In a closely knit population complex, the best evidence for this is sympatry of distinguishable populations. However, in the stringent desert conditions of the areas occupied by *Scincus*, the number of ecological niches that a given environment can support is apparently quite strictly limited. So, two species adapted to occupy more or less the same ecological space are unlikely to be able to divide their common niche to produce two viable subniches. In such cases, abutment of ranges is therefore more usual than extensive sympatry. Abutment occurs in other species groups in the Saharo-Sindian desert region. For instance, in southeastern Arabia, *Stenodactylus slevini* Haas, 1957 and *S. leptocosymbotes* Leviton & Anderson, 1967 fill very similar niches and, although their ranges are in contact and not separated by any obvious barrier, they seem to be virtually allopatric south of the Arabian Gulf (Arnold, 1977). Similarly, *Scincus mitranus* and *S. scincus conirostris* are much better differentiated morphologically than any of the populations forming the *S. scincus* complex in North Africa and are sometimes found at the same locality, yet their area of real sympatry is probably small (see p. 243).

In a poorly sampled assemblage with a huge range, like the North African *S. scincus* complex, the chances of locating the very limited areas of sympatry or abutment that might be expected are not great, but there is one situation that could be interpreted as species contact. This is in the El Golea region of northern Algeria (localities 20 to 23). At El Golea itself (locality 21) and at Ouargla (23), the *Scincus* are generally similar to those of northeastern Algeria, Tunisia and northwestern Libya (*cucullatus*), except that they are rather small. In contrast, a sample stated to come from northeast of El Golea (locality 20), collected by Hartert, is very like northwestern Algerian animals. Differences between the two populations are listed in Table 2. There is nothing in Hartert's account (1913) to suggest that his general locality is erroneous. Unfortunately he does not state precisely where his material came from, but it is unlikely to be more than 100 km from El Golea itself. If this situation really indicates the abutment or overlap of specifically distinct populations, the whole of the North African *S. scincus* complex might be interpretable as two closely related but largely allopatric species. Animals from El Golea, northeastern Algeria, Tunisia and northwestern Libya (*cucullatus*) are generally similar to those of Egypt and northeastern Libya (*scincus* s. str.), especially to the more western samples which tend to have higher mid-body scale counts and fewer narrower dark dorsal bands than the rest.

The southeastern Algerian sample, particularly the specimens from Djanet (locality 30), is also quite like Egyptian material, so all the above populations may

TABLE 2

Differences between two populations of the *Scincus scincus* complex in northern Algeria

	El Golea, Ouargla etc.	Northeast of El Golea
Sample size	13	5
Size in mm (snout to vent length of largest two ♂♂)	102, 96	134, 124
Mid-body scale count	28	26
Bands on back	frequent	none
Dark spots or bars on flanks	no	yes
Dark dorsolateral streaks on sides of head and neck	no	yes
Tail more strongly speckled than back	no	yes

form a single association. Similarly, skinks from northeast of El Golea, and northwestern Algeria (*laterimaculatus*), are apparently connected to those of Spanish Sahara, Mauretania and Senegal (*albifasciatus*) by intermediate populations in eastern Mauretania (Chinguetti, locality 5) and in southeast Morocco (Taouz, locality 16, see Pasteur & Bons, 1960). Specimens from Niger, Mali and southeastern Libya are also essentially like the *albifasciatus* populations. Such a division would leave only the Nigerian sample to be considered. This is much more like *cucullatus* type animals from the north Sahara and may be closer to these than to the geographically nearer *albifasciatus* populations. If the two groups really represent good species, the correct names for them are *S. scincus* for the mainly northern and eastern one and *S. albifasciatus* for the other. Although juveniles do not seem to be easily separable, adults could be keyed as follows.

a. No bars on flanks : dorsal bands, when present, not much wider and often much narrower than interspaces, six to nine from forelimbs to vent region **_Scincus scincus_**

b. Bars present on flanks : dorsal bands, when present, usually much wider than interspaces, five to seven from forelimbs to vent region **_Scincus albifasciatus_**

However, before such a division of North African *Scincus* can be accepted, considerably more information will be necessary. The possible abutment near El Golea needs confirming and other areas of contact or sympatry should be looked for. For the present, it seems best to refer to all these animals as the North African *S. scincus* complex and to recognize within this two groups of populations which can be informally subdivided as follows :

scincus population group
  a. Egypt and Israel (*scincus s. str.*).
  b. Northeastern Algeria, Tunisia, northwestern Libya (*cucullatus*).
  c. Southeastern Algeria.
  d. Northwestern Nigeria.
albifasciatus population group
  a. Rio de Oro to Senegal, eastwards through Mali and Niger to southeastern Libya (*albifasciatus s. str.*).
  b. Northwestern Algeria (*laterimaculatus*).

MATERIAL EXAMINED (n = 260). For southwestern Asian material, see *S. s. meccensis* and *S. s. conirostris* (pp. 221 and 223). Abbreviations etc. are explained on p. 191 and localities are shown in Fig. 5.

RIO DE ORO

1. Neighbourhood of El Aaiun ; EBD 2411, 6190–2, 6665 ; 2♂♂, 3♀♀.

MAURITANIA

2. Adrar Choum (21°20′N 12°59′W) ; MHNP 67.556 ; ♂.
3. Tasiat (= Tassiast, 21°02′N 15°15′W) ; MHNP 1937.10 ; ♀.
4. Atar ; IFAN 55.7.147–9, 152, 155, 157–60, 163, 165, 168, 170–6, 181, 183, plus two unregistered specimens ; 9♂♂, 6♀♀, 7 juv.

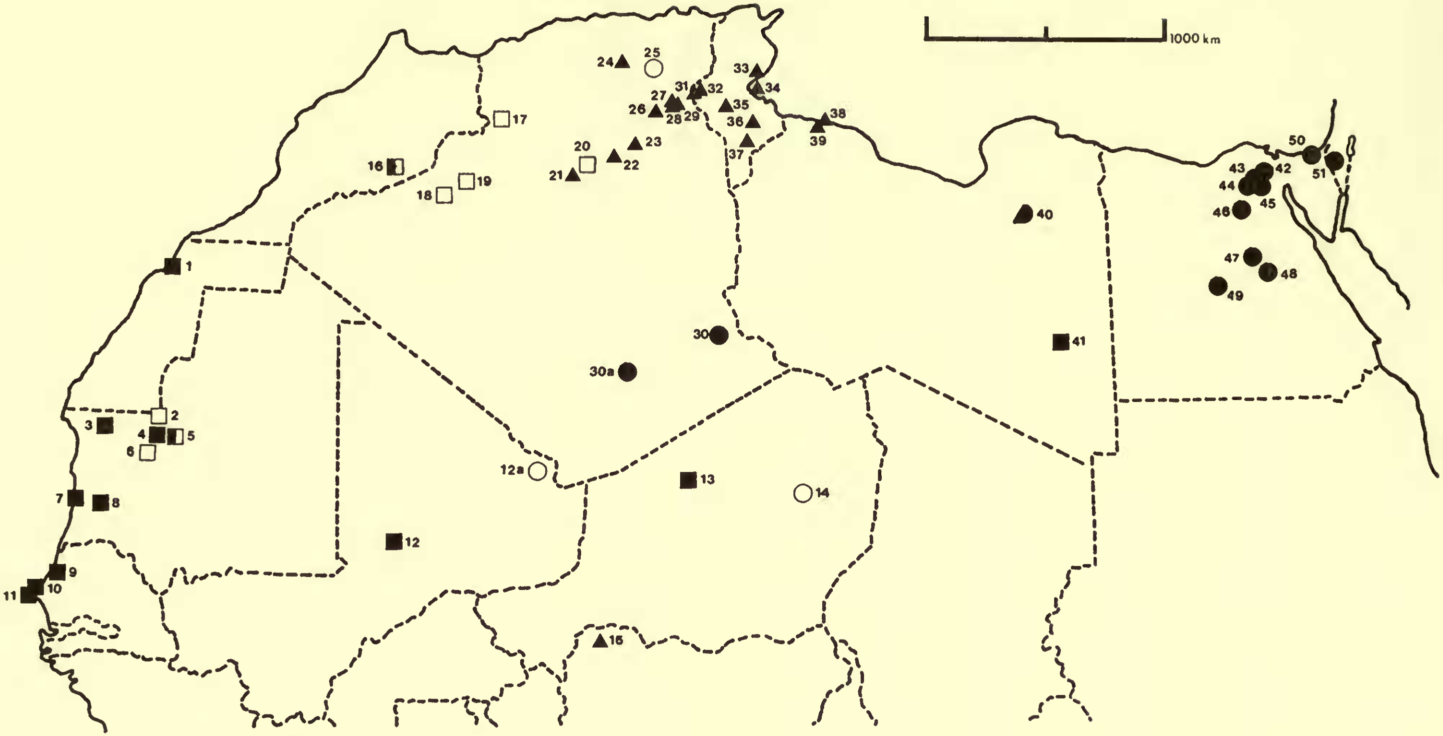

FIG. 5. *S. scincus* complex : localities and distribution of dorsal patterns in North Africa.
● – '*scincus*' : numerous bands, about as wide as interspaces ; no bars or spots on flanks.
▲ – '*cucullatus*' : few bands, much narrower than interspaces ; no bars or spots on flanks.
◭ – '*scincus*' – '*cucullatus*' intermediate.
□ – '*laterimaculatus*' : no bands on dorsum ; bars or spots present on flanks.
■ – '*albifasciatus*' : few bands, frequently much wider than interspaces ; bars or spots present on flanks.
◧ – '*laterimaculatus*'—'*albifasciatus*' intermediate.
○ – pattern unknown.

5. Chinguetti ; IFAN 55.7.150, 153–4, 156, 162, 166, 167, 169, 178–80, 182 ; 3♂♂, 6♀♀, 4 juv.
6. Legleitat (= El Gleitât, 19°59′N 13°17′W), Adrar ; MHNP 53.21 ; ♂.
7. Nouakchott ; IFAN 55.7.177 ; ♂.
8. Trarza country ; BM 1913.5.9.41*, 1913.5.9.42–4 ; 2♂♂, 2♀♀.

Senegal

9. Lompoul (15°27′N 16°21′W) ; IFAN unregistered ; 2♂♂, ♀, 2 juv.
10. Thiaroye (14°44′N 17°23′W) ; IFAN 55.18.315–17 ; 2♂♂, ♀.
11. Dakar ; BM 89.10.18.1/1946.8.13.60 ; ♂ (holotype of *S. albifasciatus*).

Mali

12. Timbouctou ; MHNP 17.86–8 ; ♂, 2♀♀.

12a. Adrar des Iforas. No material examined, but occurrence reported by Angel & Lhote (1938).

Niger

13. Oued Ifeinarem (= ? Iferouâne) ; MHNP 00.501 ; ♂.
14. Bilma. No specimens examined, but occurrence reported by Angel & Lhote (1938).

Nigeria

15. Sokoto ; BM 1966.263* ; ad. AMNH 84300–3 ; 2♂♂, 2♀♀.

Morocco

16. Tafilalt, Taouz. No specimens examined, but occurrence reported by Pasteur & Bons (1960).

Algeria

17. Ain Sefra, Prov. Oran ; BM 1913.7.3.78*, 1913.7.3.79–84, 1920.1.20.3711, MHNP 1974.313–17 ; 12♂♂, ♀.
18. Erg er Raoui, Beni-Abbès ; MHNP 53.20, 53.A.20, 53.B.20, 53.C.20 ; 2♂♂, 2♀♀.
19. Grand Erg Occidental near Beni-Abbès ; BM 1961.1636, MHNP 46.305–6, FMNH 121765 ; AMNH 91852 ; ♂, 4♀♀.
20. NE of El Golea ; BM 1912.11.9.103*, 1912.11.9.104–6, 1969.2162 ; 3♂♂, 2♀♀.
21. El Golea ; BM 1912.11.9.102 ; FMNH 62 161–6 ; 3♂♂, 3♀♀, juv.
22. Wargla (= Ouargla) to El Golea ; BM 1912.11.9.101 ; ♀.
23. Ouargla ; BM 1920.1.20.1191, 1920.1.20.1512 ; 3♂♂, ♀, juv.
24. Bou Saâda ; BM 1920.1.20.3037, MCZ 4615 ; ♂, juv.
25. Biskra ; MHNP 20.48, 20.A.48 ; 2 juv.
26. Toggourt ; BM 91.5.4.110–14, 94.7.25.5, 1969.2163–9 ; 4♂♂, 8♀♀.
27. Sif el Menadi (33°58′N 6°22′E) ; BM 1920.1.20.3848a ; ♀.
28. El Wed (= El Oued) ; BM 1909.7.28.15–18*, 1909.7.28.19–33c, 1909.7.28.34, 1920.1.20.3848 ; 13♂♂, 9♀♀, 2 juv., ad. skeleton.
29. Dunes of Debala (= Debila, 20 km north-northeast of El Oued) ; BM 91.5.4.110 ; ♂.
30. Oued Imihrou, near Djanet (= Fort Charlet) ; MHNP 36.94, 36.95, 36.A.95, 36.96, 36.A.96, 36.97, 36.A.97, 36.98, 36.A.98 ; 2♂♂, 6♀♀, juv.
30. 10 km east of Djanet, near Efri ; CAS 138557–68.

30a. Western border of Hoggar ; specimen lent by J. Bons ; ♂.
'Algiers' ; BM 69.6.22.1 ; ♀.
'Sahara' ; BM 59.11.30.3 ; ♀.

Tunisia

31. Nefta ; BM 1920.1.20.3046, MHNP 85.228–9 ; ♂, 2♀♀.
31. 30 km west of Nefta ; CAS 138850, 138852, 138998–9005, 13950B.

32. 36 km southeast of Nefta ; CAS 132786–99, 135134–6.
32. Tozeur ; MHNP 85.227 ; ♂.
33. Sfax ; ZSM 26/1952 ; ♂.
34. Gabes ; MCZ 22353 ; ♂.
35. 50 km southwest of Douz ; FMNH 81745–6 ; ♂, ♀.
36. Duirat (= Douirat) ; BM 91.5.4.115–18 ; 2♂♂, ♀, juv.
37. Djebel Sanrhar ; 40 km southwest of Bordj le Bœuf (32°11′N 10°04′E) ; FMNH 81747 ; ♂.

LIBYA

38. Tripoli ; MCZ22354 ; ♂. CAS 12751.
39. Hascian (= Qabilat al Hashshān, 32°46′N 12°55′E) ; BM 1955.1.8.70–3 ; 3♂♂, ♀.
40. Gialo (= Jalo), Cyrenaica ; BM 1932.3.6.18*, MSNG 31578 ; 5♀♀, juv.
41. Kufra, Cyrenaica ; MSNG 31577, MF 863 ; ♂, ♀.

EGYPT

42. Minyet Salamant (30°23′N 31°25′E) ; FMNH 79018–19, 79021, 79023, 79027, 79029 ;
43. Cairo ; BM 90.6.21.8–10 ; ♂, ♀, juv.
43. Giza ; BM 97.10.28.440*, 97.10.28.441–9, 1936.9.1.17–18, FMNH 69268 ; 5♂♂, 5♀♀, 3 juv.
44. El Mansuriya ; FMNH 69274 ; ♂.
45. Abu Roash, Abu Ruwash (= Abu Ruwaysh, 29°40′N 31°14′E) ; BM 97.10.28.439, FMNH 66312 ; 2♂♂.
45. Zawyet (= Zawirat) Abu Musallem (29°56′N 31°10′E) ; FMNH 69277 ; ♂.
46. Wadi Muwellih (= Muweilih), Faiyum ; FMNH 164665–70 ; 3♂♂, 2♀♀, juv.
47. Manfalut ; FMNH 81184–5 ; ♂, ♀.
48. 3 km northwest of Durunka, Asyut ; FMNH 81179 ; ♀.
49. 35 km N of Mount Dakhla – sandy area ; FMNH 171834 ; ♀.
49. Dachel (= Dakhla) oasis ; ZSM 840/0.
50. El Arish, northeastern Sinai ; FMNH 58555 ; juv.
    'Libyan Desert' ; ZSM 3/1974 ; 2♂♂.

ISRAEL

51. Revivim ; BM 1961.690 ; ♀.

Scincus scincus meccensis Wiegmann

Scincus meccensis Wiegmann, 1837 : 127. Type locality : 'Arabia'. Location of type : Zoologisches Museum der Humboldt Universität zu Berlin (Registered number : ZMB 1178).

Scincus deserti Haas, 1957 : 76. Type locality : 23 miles [37 km] North of Hail, Saudi Arabia. Location of type : Hebrew University of Jerusalem (Registered number : HUJ 2674).

DIAGNOSIS. A subspecies of *S. scincus* in which the head is apparently not markedly expanded in large animals and which has the frontonasal in contact with both the rostral and the anterior loreal in nearly all cases. Adults have fine dappled dorsal pattern of lighter and darker spots, often interspersed with light, sometimes translucent scales that are yellow or orange in life and are frequently arranged in short transverse bars. Dark vertical bars or spots are present on flanks of adults.

EXTERNAL FEATURES. Head fairly large ; in mature males not more than slightly broader than neck and body at level of forelimbs ; length in animals of over 70 mm varies from about 23 to 25% of snout to vent distance, width is about 55–63% of head length. Top of head rises gently in lateral profile as in many *S. mitranus*.

Rostral typically contacts frontonasal at least narrowly (two exceptions out of 17 animals checked). Supraoculars usually 5 : 5 or 6 : 6 (5 : 5 in 12, 5 : 6 in three, 6 : 6 in 13).

Nostril oval or slightly crescentic ; rostral usually excluded from its border (one exception). Three loreal scales on each side ; first in contact with frontonasal.

Usually four or five nuchals on each side (although unilateral counts may vary from three to five). Dorsal scales smooth in adults and juveniles. Mid-dorsals more or less subequal to mid-ventrals. 24 to 28 scales around mid-body (see Table 3).

TABLE 3

Southwest Asian *S. scincus:* geographical variation in mid-body scale count and in number of nuchals

	Mid-body scale count							Number of nuchals (higher unilateral count)							
	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8
Iran			2		5					5					
Iraq			1		2		1				4				
NE. Arabia			6		2						3	4			
SE. Arabia	2										2				
S. and SW. Arabia		1	6	1							4			1	1
S. Jordan, NW. and W. Arabia	6		7	1	4						7	10			

All listed populations are *S. s. conirostris*, except the last which is *S. s. meccensis*

COLOUR AND PATTERN. Dorsal colouring generally very similar to that of *S. s. conirostris* (p. 222), both in living and preserved animals. Differs mainly in presence of vertical bars or blotches on flanks of non-juveniles. These vary in colour from pale pink or orange-brown to deep purple-brown. They may develop in animals as small as 62 mm. Iris blackish in life.

SIZE. A relatively small race in which, as in other *Scincus*, males are larger than females. Largest males examined are 105 mm, 91 mm and 91 mm snout to vent ; largest females 76 mm, 75 mm and 75 mm. Animals up to 51 mm long have umbilical scars.

GEOGRAPHICAL VARIATION. Small sample size restricts comment, but there are no obvious trends discernible, except that reduction of the supraoculars to 5 : 5 is commoner in the south and mid-body scale counts are higher in Jordan (28 or 27 instead of 24 to 26).

SYNONYMIZED FORMS. *S. deserti* Haas, 1957 falls clearly within the range of variation of *S. s. meccensis*. Haas states that this form has four fringed scales covering the ear, but the paratype of *deserti*, and all other *S. s. meccensis* examined, have the ear covered by two scales, each with two main lobes, as in most other members of the *S. scincus* complex.

DISTRIBUTION (Fig. 6). Known only from northwest Arabia and south Jordan. It extends south on the Red Sea coast at least to the Jiddah area and eastwards at least to a point 37 km north of Hail (i.e. 27°35′N 41°45′E), the type locality of *S. deserti*.

MATERIAL EXAMINED (n = 28). Abbreviations etc. are explained on p. 191 and localities are shown in Fig. 6.

JORDAN

1. Guweira (= El Quweira) to Aqaba ; HUJ 1360 ; juv.
1. Wadi Rum ; MF, BM 1976.1715 ; ♂, 3 juv.
2. Mudawara (= Al Mudawwarah), 'Central Arabia' ; HUJ 2673 ; juv.

SAUDI ARABIA

3. 27°20′N 38°30′E ; BM 1964.147 ; ♀.
4. 26°50′N 38°15′E ; BM 1964.146 ; ♂.
5. 30 km NE of Yanbu al Bahr, 24°13′N 38°19′E ; CAS 119213.
6. Jiddah ; BM 1935.2.1.20, 1975.992 ; ♂, ♀.
6a. Wadi Resifa or Wadi Fatma; BM 1976.1860 ; juv.
7. 19 miles [30·5 km] south of Jiddah, 21°12′N 39°12′E ; BM 1964.302*, 1964.303 ; 2 juv.
8. Royal Saudi Naval Reservation, from coast to 6 km inland between 21°07′N and 21°21′N ; CAS 136485 – 136494.
9. Burayman, 21°39′N 39°13′E ; BM, unregistered live specimen.

IMPRECISE LOCALITIES

Arabia ; ZMB 1178 ; ♀ (type of *S. meccensis*).
Arabia ; BM 1964.148* ; ♀.
'Central Arabia' ; HUJ 2752 ; ♂ (paratype of *S. deserti*).

Scincus scincus conirostris Blanford

Scincus conirostris Blanford, 1881 : 677, fig. 1. Type locality : Tangyak, 7 miles [11 km] south of Bushire (Iran). Location of types : British Museum (Natural History) (Registered numbers : BM 79.8.15.1–3/1946.8.20.55–7).

Scincus gasperettii Haas, 1957 : 75, fig. 10. Type locality : Dhahran (Al Hasa district, Saudi Arabia). Location of type : California Academy of Sciences (Registered number : CAS 84519).

DIAGNOSIS. A subspecies of *S. scincus* differing from other populations in the following combination of features : snout often rather short and not as spatulate as in other forms, head frequently quite broad in large animals, rostral and loreals nearly always separated from frontonasal. Adults have fine, dappled dorsal pattern of lighter and darker spots, often interspersed with light, sometimes translucent scales that are yellow or orange in life and are frequently arranged in short irregular transverse bars. No dark vertical bars or spots present on flanks.

EXTERNAL FEATURES. Head fairly big, and in large animals is often distinctly broader than the neck and the body at the level of the forelimbs ; length in animals over 80 mm may be about 20–26% of snout to vent distance, and width about 55–70% of head length. Snout is frequently rather short and this combined with the often wide temporal region gives a characteristic profile in old animals (see Pl. 2a).

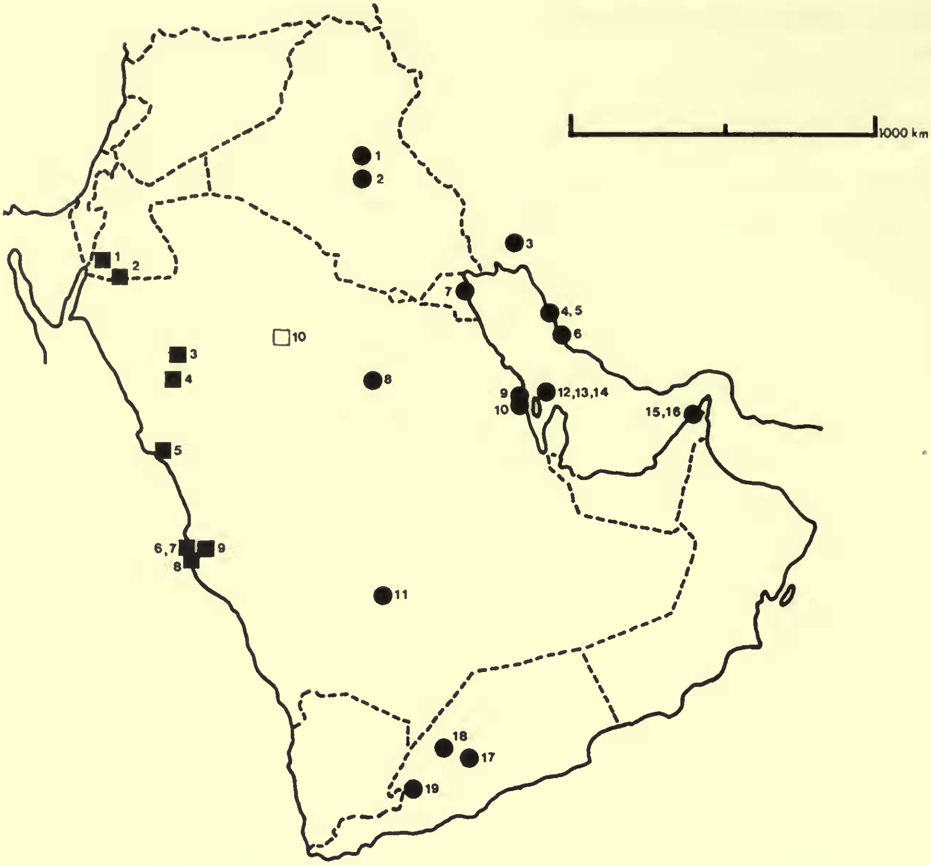

FIG. 6. *S. scincus:* localities in southwest Asia. Figures refer to entries in lists of material examined.

■ – *S. s. meccensis.*

□ – Type locality of *S. deserti* (= *S. s. meccensis*).

● – *S. s. conirostris.*

Rostral separated from frontonasal by the internasals (one exception out of 29 animals examined). Supraoculars typically 6 : 6 (5 : 6 in one case and 5 : 5 in seven) ; supraciliaries usually 4 : 4 (but vary from 3 to 5).

Nostril oval ; three loreals on each side, the first nearly always separated from the frontonasal (one exception out of 29). Ear covered by a single scale in one instance.

Usually three to five nuchals on each side of neck but number can vary from two to eight. Dorsal scales smooth in adults and juveniles ; mid-dorsals subequal to mid-ventrals. 24 to 30 scales around mid-body.

COLOUR AND PATTERN. Dorsal ground colour (in spirit) varies from pale cream, straw or grey to warm greyish-buff-brown. Young animals are finely dappled with light and dark markings. Dappled pattern is retained by adults, but often becomes interspersed by paler, often at least partly translucent scales on the body that may be scattered, but are usually arranged in irregular transverse rows ; sometimes these go right across the back or they may be confined to dorsolateral areas. Dappled dorsal pattern varies in intensity and is usually absent from the tail and head, and often also from the neck and even from the forebody. There are no vertical bars or spots on the sides.

In life (animals from Bahrain and United Arab Emirates), tail may be lighter than back, the translucent scales are orange or deep yellow and the feet are pale yellow this colour may also occur in irregular blotches on the flanks. Iris dark brown with gold reflections.

SIZE. Largest males examined are 112 mm, 109 mm, 105 mm, 98 mm and 96 mm snout to vent ; largest females are 98 mm, 82 mm, 77 mm and 69 mm. Two animals, respectively 37·5 mm and 46 mm snout to vent, have umbilical scars.

GEOGRAPHICAL VARIATION. The small sample available makes assessment of geographical variation difficult. The largest animals come from the south (Hadhramaut), but there is no clear evidence of size trends. Number of scales around the body is highest in the north and may be lowest in the southeast. In contrast, number of nuchals is lowest in Iran (see Table 3). Animals from around Dhahran, Bahrain and the eastern United Arab Emirates have only five pairs of supraoculars instead of six.

SYNONYMIZED FORMS. *S. gasperetti* Haas, 1957 is based on animals with five instead of six supraoculars on each side, otherwise it is indistinguishable from *S. s. conirostris*.

DISTRIBUTION. Known from south and east Arabia, Iraq and southwest Iran. In southern Arabia, it occurs in the eastern United Arab Emirates, Hadhramaut and Wadi Dawasir, but does not appear to traverse the highlands separating the interior of the peninsular from the southwestern coast. In northern Arabia, *S. s. conirostris* extends westwards at least as far as 45°E. In Iraq, it is known from the Baghdad area and in Iran it is confined to the provinces of Khuzistan and Fars.

REMARKS. *S. s. conirostris* is known only from rather scattered localities. In Arabia, it is far less common, and less often encountered than the partly sympatric *S. mitranus*.

MATERIAL EXAMINED (n = 29). Abbreviations etc. are explained on p. 191 and localities are shown in Fig. 6.

IRAQ

1. Baghdad ; FMNH 20863, 20865.
2. Hindia (= Hindiyah) Dam ; SMF 55583–4 ; ad., juv.

IRAN

3. Agha Jari, Fars Province ; CAS 86479–80.
4. Bushire ; BM 87.9.22.40 ; ♀.
5. Tangyak, 7 miles [11 km] south of Bushire ; BM 79.8.15.1–3/1946.8.20.55–7 ; 2♂♂, juv. (types of *S. conirostris*).
6. Tangistan (= coastal area south of Bushire) ; BM 87.9.22.41 ; ♀.

KUWAIT

7. Near Kuwait town ; BM 1972.1311* ; ad.

SAUDIA ARABIA

8. Jarrab (= Jirab), 26°45′N 45°00′E ; BM 1964.145 ; ♂.
9. Dhahran ; CAS 84519 (holotype of *S. gasperettii*).
10. Abqaiq ; FMNH 73986 (paratype of *S. gasperettii*).
11. Wadi Dawasir ; BM 1963.801, 1963.802* ; ♂, ♀.

BAHRAIN

12. Ra's Jazayir, 25°58′N 50°28′E ; BM 1971.116 ; ♀.
13. South of Amar ; BM 1975.989, unregistered live specimen ; ♂♂.
14. South Bahrain ; MCZ 52064 ; ♂.

UNITED ARAB EMIRATES

15. Near Jazirat al Hamra, 25°38′N 55°44′E, between Umm al Qaywayn and Ra's al Khaymah ; BM 1972.1365 ; juv.
16. Ra's al Khaymah ; BM 1975.988* ; ♂.

DEMOCRATIC REPUBLIC OF YEMEN

17. Hadhramaut (collected on T. Bent's 1893–4 expedition to Hadhramaut, these specimens may have been taken in Wadi Hadhramaut itself between Haynin and Shibam, or possibly on the route from Mukkala, or on the way back to the coast at Shihr) ; BM 97.3.11.101–2 ; ♂♂.
18. Husn al Abr ; BM 1956.1.7.74 ; ♂.
19. Ataq ; BM 1956.1.7.73* ; ♂.

IMPRECISE LOCALITY

'S. Hejaz' (these two specimens, which are without further locality, are part of a collection made by H. StJ. Philby and stated to come from southern Hejaz. However, other material in the collection is known to come from as far south as the western Democratic Republic of Yemen. All precise localities are east of the coastal mountains of western Arabia) ; BM 1938.2.1.67–8 ; ♂♂.

Scincus mitranus J. Anderson

Scincus mitranus J. Anderson, 1871 : 115. Type locality : 'Arabia'. Location of type : Zoological Survey of India, Calcutta (Registered number : unavailable).

Scincus arenarius Murray 1884 : 353. Type locality : Hubb (= Hab) Plains, Sind, Pakistan. Location of types : two of the seven types are in the British Museum (Natural History) (Registered numbers : BM 87.9.22.42/1946.8.20.59 ; BM 86.6.30.52/1946.8.20.58) ; the others may be in Karachi, but it has not been possible to confirm this.

Scincus muscatensis Murray 1886 : 67. Type locality : 'Muscat'. Location of types : three of the 13 types are in the British Museum (Natural History) (Registered numbers : BM 85.7.11.16–18/1946.8.20.68–70) ; the others may be in Karachi.

Scincus arabicus Schmidt, 1939 : Type locality : 'near Shabwa, Hadhramaut' (= Shabwah, Democratic Republic of Yemen). Location of type : Field Museum of Natural History, Chicago (Registered number : FMNH 18460).

Scincus philbyi Schmidt 1941 : 162. Type locality : 'Anaiza' (= Unayzah), Saudi Arabia. Location of type : Field Museum of Natural History, Chicago (Registered number : FMNH 31664).

Scincus richmondi Haas, 1961 : 24. Type locality: Southeastern Jafura Desert, Al Hasa District, Saudi Arabia. Location of type: Carnegie Museum, Pittsburgh (Registered number CM 33535).

DIAGNOSIS. Head relatively small; external ear orifice very small but visible, usually situated well below level of line made by lower edges of upper labial scales and typically covered by two scales, the hind edges of which are usually serrated over the orifice (rarely covered by a single, less serrated scale). Eye with relatively small cornea and a rounded pupil. Rostral scale broadly borders frontonasal; frontoparietals in usually extensive contact (rarely fused or separated); parietals relatively small (usually less than twice the length of adjoining nuchals). Dorsal scales smooth, mid-dorsals subequal to mid-ventrals (rarely more than slightly larger or smaller). (25) 26 to 30 (31) scales around mid-body. Adults and young without bold dorsal pattern, either almost uniform or with fine dappled pattern of lighter and darker spots; dark bars or spots present on flanks of nearly all adults.

Auditory meatus long with some fairly well-developed scales distally and a long cartilage in its lateral wall. Extrastapes an elongate plate. Premaxillary rostrum long. Otic capsule normal; squamosal quite sharply flexed, its upper border often forming a small spur. Distal section of supratemporal process of parietal not constricted, terminating well above level of ventral tip of squamosal.

EXTERNAL FEATURES. Head small, a little narrower or at most slightly broader than neck and body at level of forelimbs; length in animals over 80 mm may be about 19–24% of snout to vent distance; width about 55–65% of head length. Some variation exists in snout proportions. Sides of snout usually at least slightly concave when viewed from above. Top of head rises relatively gently from snout-tip. Canthus rostralis quite well marked; loreal region distinctly concave. Tail broader than deep proximally, clearly laterally compressed towards tip; up to 80% of snout to vent distance when undamaged.

Rostral overhangs mental strongly, more so than in sympatric *S. scincus*; prefrontals in contact, or fused (in north of range). Frontal often much wider in front than behind, often more so than in the *S. scincus* complex. Frontoparietals in usually extensive contact (rarely fused). Parietals relatively small, in most cases once to twice the length of adjoining nuchals. Supraoculars nearly always 6 : 6 (very rarely 5 : 6 and said to be 5 : 5 in type); supraciliaries usually four on each side (but up to seven may be present).

Nostril oval or quite strongly crescentic, often in narrow contact with rostral shield. Often three loreals on each side (but first absent in north of range); if present, first loreal usually separated from frontonasal (but not in animals from Masirah Island and from 'Muscat'). Upper labials fairly deep (third is about 1·5 to 2·8 times depth of second loreal); typically eight on each side, but number varies from seven to nine. Ear orifice very small but visible, situated usually well below level of line made by edges of upper labials; typically covered by the contiguous parts of two scales, the posterior edges of which are nearly always at least slightly serrated over actual orifice (in nine out of 101 animals checked for this feature, scales covering ear coalesce and may appear as a single plate, often with reduced serration).

Typically three to five pairs of nuchals, but sometimes less and nuchals may even be absent. Dorsal scales smooth in adults and juveniles ; mid-dorsals subequal to mid-ventrals (rarely more than slightly wider or narrower). (25) 26 to 30 (31) scales around mid-body. Row of laterally expanded scales on dorsal midline of tail usually quite developed, typically extending proximally almost to the level of extremities of posteriorly adpressed hindlimbs, or a little beyond.

Parts of scales forming posterior digital fringes often relatively broad and less acutely pointed than in *S. hemprichii*, and the outer border of each is more curved. Claws and ungual lamellae often strongly expanded laterally.

COLOUR AND PATTERN. Dorsal ground colour varies from pale buff or grey to warm brown or deep cinnamon. This colour may change somewhat in spirit, but in life, in combination with other pattern elements, generally matches the sand on which the individual is found, although there is some variation within populations. This colouring does not change, persisting for at least four years in captivity, even when animals are kept on contrasting backgrounds. Young animals may be almost uniform above or finely dappled with dark or light spots, or more usually with both. Adults possess a similar dappled dorsal pattern. Usually, this consists of one (or two) dark spots, sometimes confined to the posterior edge of the scale and bordered and separated by light, often whitish pigment. Both these elements may eventually extend forwards to cover a greater part of the scale. There is considerable variation in intensity and extent of the markings, even within populations ; in animals from 'Muscat' and Masirah Island, the light spots are often large and form broken longitudinal lines along the back. The head usually lacks dappled patterning. The distal part of the dorsal surface of the tail is often reddish or light bluish, especially in young animals. The flanks and limbs are paler than the back and there may be some grey pigment, especially on the sides of the head and neck.

In life, most animals (at least non-juveniles) have some deep yellow or orange pigment, although this rapidly disappears in alcohol. It is found on the feet where it is intense, on the upper surfaces of the limbs and as a series of short transverse bars situated dorsolaterally on the body and tail-base. At least some of those on the body extend upwards from the dark bars or spots on the flanks. There may also be yellow blotches between the dark bars or spots.

Adults usually have a row of spots or short vertical bars on the flanks that vary in colour from pale pink through red to a very deep warm brown. They begin in front of the forelimbs and often extend to the groin and sometimes onto the tail-base as well. Often these flank bars decrease in size and intensity posteriorly. The number and spacing of bars or spots present and their size, shape and colour vary and there are often both individual and local differences. There is usually one or more rarely two bars in front of the forelimbs and from four to ten between the two pairs of legs. These markings are absent in hatchlings but may develop in animals as small as 57 mm snout to vent and, by the time they reach 70–80 mm, the majority have them. Above this size they are only occasionally absent (largest animal encountered without bars is a male, 105 mm snout to vent).

Underside whitish or cream. Iris very dark brown.

EYE. Cornea relatively small, about 33–38% (n = 4) of the horizontal diameter of the eye. Pupil roundish, not a vertical slit when contracted.

EAR (see Fig. 2). Meatus long, its distal portion lined with scales, but these are less well developed and the meatus is less thick-walled than in the *S. scincus* complex. The cartilage in the lateral wall of the upper section of the meatus is long and pointed. Tympanum somewhat smaller (compared with skull length) than in the *S. scincus* complex. Distal section of the extrastapes forms an anteroposteriorly expanded cartilaginous plate that occupies a considerable area of the tympanum. Stapes slightly more robust than in the *S. scincus* complex, with a larger foot-plate.

SKULL (see Fig. 2). Premaxillary rostrum strongly developed. Squamosal quite strongly flexed and there may be a small upward spur bordering the supratemporal process of the parietal. Surface exposure of the latter is not constricted ventrally, but it terminates well above the level of the ventral tip of the squamosal. Supratemporal bone larger than in the *S. scincus* complex, smaller than in *S. hemprichii*. Otic capsule not, or not much, bigger than in the *S. scincus* complex and much smaller than in *S. hemprichii*; in lateral view, its posterior border is often clearly visible behind the supratemporal bone and the supratemporal process of the parietal. Maxillary teeth about 15–20 in adults. Mandibular teeth about 13–18.

SIZE. There are some indications of local variation in size, but these do not seem to follow any consistent pattern. Adult males are considerably larger than adult females and the majority are over 100 mm from snout to vent, whereas most females are less than this. Largest five males examined are 134 mm, 126 mm, 123 mm, and 121 mm and the largest five females 105 mm, 104 mm, 104 mm, 94 mm and 92 mm. The smallest juvenile encountered is 38 mm, and umbilical scars are visible, although fading, on animals up to 50 mm.

GEOGRAPHICAL VARIATION. Snouts tend to be rather short and broad in the north and northwest of the range and are longest and narrowest on Masirah Island. Some other features of *S. mitranus* that vary geographically are displayed in Table 4. From this it will be apparent that mid-body scale counts are lowest in the southeast but often show considerable local variation. Northern animals almost always have the prefrontals fused and two loreals on each side. In the Al Hasa region (localities 5 to 9, 13, 14) various combinations of prefrontal arrangement and loreal number occur. Animals from the western United Arab Emirates (localities 23 to 29) have unfused prefrontals; most have three loreals on each side, but some (9 out of 45) have only two. Elsewhere, three loreals are almost always found, but fused prefrontals may occur as a minority condition.

Apart from their low mid-body scale counts, animals from 'Muscat' and Masirah are peculiar in consistently having the first loreal in contact with the frontonasal. Also, the light spots in the dappled dorsal pattern are often large and tend to form broken longitudinal stripes.

The name *S. philbyi* Schmidt 1941 is available for the northern populations with rather broad snouts, fused prefrontals and two loreals on each side, but it seems unwise, without a more searching analysis, to recognize a subspecies largely on two minor scale characters, especially when there is a large area where one or both of

TABLE 4

Geographical variation in *Scincus mitranus*

Region	Mid-body scale count							First loreal, if present, contacts	Loreal scales on each side		Prefrontals	
	25	26	27	28	29	30	31	frontonasal	3	2	separate	fused
Northern Arabia (localities 1 to 4, 10, 11)		1		**10**		**8**		—	3	**19**	—	**19**
Dhahran etc. (localities 5 to 9)		3	3	**38**	2	7		—	18	**32**	11	**40**
Jafurah etc. (localities 13, 14)				2		**11**	1	—	**11**	3	**14**	—
Qatar and western United Arab Emirates (localities 23 to 29)		1		10	4	**32**		—	**36**	9	**46**	—
Eastern United Arab Emirates (localities 30 to 34)		7	4	**25**		1		—	**39**	—	**38**	2
Central Arabia (localities 12, 15 to 17)				3	1	**9**		—	**13**	—	**11**	2
Southwest Arabia (localities 18 to 21, 39, 41, 42)				**9**	1	**8**		—	**17**	1	**15**	3
Southern Rub-al-Khali (localities 22, 37, 38)				1		2		—	3	—	2	1
'Muscat' and Masirah (localities 35, 36)	1	**7**	1					+	**10**	—	**10**	—

these exist alongside more typical arrangements. The 'Muscat' and Masirah populations, for which the name *S. muscatensis* Murray, 1886 is available, may be largely separated from the rest of the range of *S. mitranus* by unsuitable, non-sandy country, so they could well be subspecifically distinct. However, only ten specimens are presently available to us and most of these come from the probably imprecise locality of 'Muscat' (see p. 231). Until southeast Arabia is better collected, it seems safer to reserve judgement about the status of these animals.

SYNONYMIZED FORMS. *S. philbyi* and *S. muscatensis* have already been discussed above and *S. arenarius* is dealt with under DISTRIBUTION. *S. arabicus* Schmidt, 1939 is based on two juvenile specimens, 48 mm and 46 mm snout to vent. The former is the holotype and comes from Shabwa (= Shabwah), and the paratype is from Wadi Beihan, both localities in the the Democratic Republic of Yemen. Both agree very closely with *S. mitranus*. The absence of dark bars on the flanks mentioned by Schmidt is to be expected in animals of this size, and the digital fringes, said to be poorly developed, are well within the range of variation for this species. The author also states that the parietals are broken into small transverse scales, but apart from the left frontoparietal of the holotype being divided in two, the head scaling is quite normal for *S. mitranus.*

S. richmondi Haas, 1961 also falls well within the range of variation encountered in *S. mitranus.*

DISTRIBUTION. (Fig. 7). Restricted to south and east Arabia. In the south, it occurs from southeastern Sultanate of Oman to the lowlands of southwestern Saudi Arabia, east Yemen and the western Democratic Republic of Yemen, but it does not appear to cross the high mountains that separate the interior of Arabia from the southwestern coast of the peninsula, nor is it known from the southern coast west of Masirah Island, except for seven specimens reported from Gischin (=Qishn) by Steindachner (1903). In the north, it reaches Kuwait at about latitude 29°. Its northwestern limits are uncertain, but they extend at least as far as Unayzah (26°06′N 43°58′E) and Jabal al Alam (23°36′N 43°31′E).

Pakistan records. S. mitranus was recorded from Pakistan by Murray (1884) under the name *S. arenarius.* He described this taxon on the basis of seven individuals said to come from Hubb (= Hab) Plains, Sind, but there is considerable circumstantial evidence suggesting that this locality is erroneous. Firstly, no *Scincus* appear to have been collected in Pakistan since Murray's description and, as Minton (1966) says, 'it is somewhat surprising that a rather large and distinctive reptile should not be rediscovered in the relatively well-collected lower valley of the Hab River'. Secondly, Murray's specimens seem to be well within the range of variation of the Arabian *S. mitranus.* Two of the types of *S. arenarius* are in the British Museum, and these differ slightly in their head scaling: one has the prefrontals fused and three labials on each side, and the other, prefrontals separate and two labials. As has been pointed out (p. 227), these two combinations of loreal and prefrontal arrangement are relatively common only in a small area of the total range of *S. mitranus,* namely the Al Hasa region of eastern Arabia, which is more or less opposite Bahrain Island. Murray's material also agrees with the Al Hasa skinks in other respects. It would be curious if an isolated population of *Scincus,* separated (over land) by a distance of almost 2000 km from its nearest relative, should resemble the Al Hasa population so closely. Thirdly, there are good reasons for believing that specimens of an Arabian *Scincus* could turn up in Pakistan for lizards of this genus have a long history of medical use and were frequently items of trade. *Scincus* was long valued as an antidote to poisons in Europe, while in the East it had more hedonistic uses. Anderson (1898) states that 'among Arabs it was in high repute as a remedy for reanimating the powers exhausted by age or debauchery, and in eastern countries fables are still extant regarding its potency in this respect'. This author (1871) confirms the use of *Scincus* in the Indian subcontinent, particularly as an aphrodisiac amongst the Muslim population, and it is perhaps significant that the type locality of *S. arenarius* is in a Muslim area and near a large sea-port (Karachi, where Murray worked). It seems very likely that eastern Arabia was the main source of *Scincus* for the Pakistan pharmaceutical market, for it is the closest area (by sea) that is certainly within the range of the genus and there is a long history of trade between the Irano-Arabian Gulf and Pakistan and western India. Trade in *Scincus* was certainly still going on in Murray's time. The type of *S. mitranus* was purchased in about 1871 as a dried specimen in India or Pakistan from a merchant who said that he had brought it from Arabia (Anderson, 1871). Indeed, over 30 years later in 1904 the British Museum received a *S. mitranus* (BM 1904.3.25.1) from a London trading company which had obtained it through a Bombay merchant who, in turn, had imported it from Arabia. He told the trading company that the *Scincus* had medicinal properties. Remarks of Cheesman (1926) suggest that the east Arabian *Scincus* trade continued for some time after this.

Another line of evidence concerns the way in which Murray's specimens had been treated after capture. From Anderson (1898) and examination of BM 1904.3.25.1 it is apparent that Arabian skinks prepared for commerce were roughly cut along the belly and all or part of the guts removed; the carcase was then dried, presumably in the sun, when it sometimes became fly-blown. The two Murray specimens in the British Museum show all of these features.

It seems, therefore, that Murray was probably misinformed about the locality of his *S. arenarius* and that these animals really came from Arabia.

Sex ratio. Of the animals over 70 mm that were sexed, 69 are males and 33 females. Of 22 adults collected near Shajah, 16 are males. This disparity may be more apparent than real, possibly males are less retiring than females, at least at certain times of the year.

Material examined (n = 244). Abbreviations etc. are explained on p. 191 and most localities are shown in Fig. 7.

Kuwait

1. Kuwait; BM 1976.1859; ♂. Unregistered live specimen.

Saudi Arabia

2. Anaiza (= Unayzah); MCZ 53930; ♂ (paratype of *S. philbyi*). FMNH 31664 (holotype of *S. philbyi*); FMNH 28599 (n = 6, paratypes of *S. philbyi*).
3. Zilfi; BM 1963.803–4; ♀.
4. Shaib Atj (= Wadi al Atk, 26°00'N 46°30'E); BM 1935.10.8.16*–21; 4♂♂, ♀, juv.
5. Jubail (= Al Jubayl); BM 1953.1.8.53; ♀.
5. Ras Tamura (= Ra's Tannurah); AMNH 66602.
6. Qatif; CAS 84414.
6. El Alat; CAS 84435.
6. Dhahran; FMNH 74003; ♀. CAS 84535, 84580–7.
6. Shimal; CAS 84427, 84429.
6. Tomayiah; CAS 84626.
7. Abqaiq; FMNH 74004, HUJ 7087, MCZ 80925; ♂, 2♀♀. CAS 84296, 84303, 84305–6, 84308–10, 84313, 84315–17, 84320, 84324–9, 84487–9, 84494.
8. Jurdah (= Judah), NW of Hufuf; BM 1947.3.2.23*–29; 6♂♂, 3♀♀.
9. Zanuza, Hufuf; BM 1924.11.18.16; ♂.
9. Near Hufuf; BM 1953.1.8.54; ♂.
10. Dahna, 100 km east of Riyadh, 25°08'N 47°44'E; CAS 119202–3.
10. Dahna, 25°00'N 47°30'E; CAS 134138–40.
11. Riyadh; SMF 55014; ad.

12. Northwestern fringes of Jabal al Alam, 23°36′N 43°31′E ; CAS 113717.
13. Wadi Sahaba (= Wadi as Sahba) ; BM 1924.11.18.17 ; ♀.
14. Jafurah ; BM 1932.10.1.83*–91, 1924.11.18.15 ; 8♂♂, 2♀♀.
14. Southeastern Jafurah desert ; CM 33513, 33517, HUJ 7920 (originally CM 33516) ; 2♂♂, ♀. CAS 93034 (originally CM 33518) (all are paratypes of *S. richmondi*).
15. Irq Minttar, in Uruq Rumaylah, 20°15′N 46°45′E ; CAS 119216–19.
16. Near Irq Abu Faqr, 75 km south, 69 km west of Rayda well, 20°15′N 47°15′E ; CAS 119249–51.
17. Irq Kabdan, 21°00′N 48°40′E ; CAS 119244–8.
18. Bir Husayniyah, edge of Wasi Habawnah, 17°49′N 44°27′E ; CAS 119207–9.
19. Khobash, 17°33′N 44°49′E ; CAS 119210, 119241.
20. 17°16′N 46°16′E ; CAS 119235–8.
21. Near Ash Sharawrah, 17°29′N 47°07′E ; CAS 119239–40.
22. Shanna, 1000 ft [300 m], 18°55′N 51°05′E ; BM 1931.7.16.55* ; ♂.
23. 22°10′N 54°21′E ; BM 1971.1348–9 ; ♀, juv.

Qatar

24. Qatar ; BM 1950.1.5.12–13 ; 2♂♂.

United Arab Emirates

25. Al Hamra (24°01′N 52°25′E) ; BM 1971.758–9, 1972.840 ; ♂, 2 juv.
26. Between Al Hamra and Bada Haza (23°40′N 52°36′E) ; BM 1972.841–2 ; 2 juv.
27. 23°45′N 53°33′E ; MCZ 85562 ; ♂, CAS 97768–75, 97777–9, 97786–90, 97792–96, 98091.
27. Habshan, 23°50′N 53°37′E ; CAS 97780–5.
27. Near 23°41′N 53°28′E ; CAS 97776.
28. Near Bada Zaid, 23°35′N 53°50′E ; BM 1972.1260–2 ; ♂, 2♀♀.
29. North edge of Liwa ; BM 1971.1747–8 ; ♂, ♀.
29. Al Liwa area ; BM 1971.542–5 ; 2♂♂, 2 juv.
30. Between Abu Dhabi and Al Aga ; BM 1971.1654 ; juv.
31. Bereimi (= Buraimi) ; BM 1950.1.5.11 ; ♀.
33. Sharjah ; BM 1970.1594*, 1971.1023–4, 1975.1305, 1972.1366–7, 1973.734–5, 1973.2088–103, 1975.985–6, 1975.990, HUJ 2671 ; 16♂♂, 6♀♀, 5 juv.
34. South of Jazirat al Hamra, 25° 38′N 54°44′E ; BM 1973.2087, 1975.980–1 ; ♂, 2♀♀.
34. Ra's al Khaymah ; BM 1975.982–3, 1975.987 ; 3♂♂, juv.
32. Jebel Fayah (= Jebel al Fajah), 25°06′N 55°50′E ; BM 1971.1304, 1975.991 ; 2♂♂, ♀.

Sultanate of Oman

35. 'Muscat'. It is unlikely that the locality attached to these individuals indicates the town of Muscat. This is situated in a largely rocky area not obviously suitable for *Scincus* and none appears to have been taken there since the listed specimens were obtained in the 1880s. 'Muscat' has sometimes been used in a more general way for the eastern section of the Sultanate of Oman. Certainly, some of the other reptile material of A. S. G. Jayakar, who obtained a proportion of the *S. mitranus* listed here, may not have come from the immediate environs of Muscat town itself. Mrs F. E. Warr (personal communication) points out that Jayakar collected fossils in the sandy Ash Sharqiyah region southwest of Muscat and some of his bird material labelled 'Muscat' is likely to have come from here. So this may also be the origin of some of his reptiles.) BM 85.7.11.16–18/1946.8.20.68–70 (types of *S. muscatensis*), 85.11.7.9–10, MCZ 112246, AMNH 17821 : 4♂♂, ♀, 2 juv.
36. Masirah ; BM 1971.1025, 1973.405, 1975.984 ; 2♂♂, ♀.
37. Ramlat Shu'ait, 1000 ft [300 m], 18°40′N 52°10′E ; BM 1931.7.16.54 ; ♀.
38. Kharaiyim Fasad, 850 ft [255 m], 18°30′N 53°10′E ; BM 1931.7.16.56 ; juv.

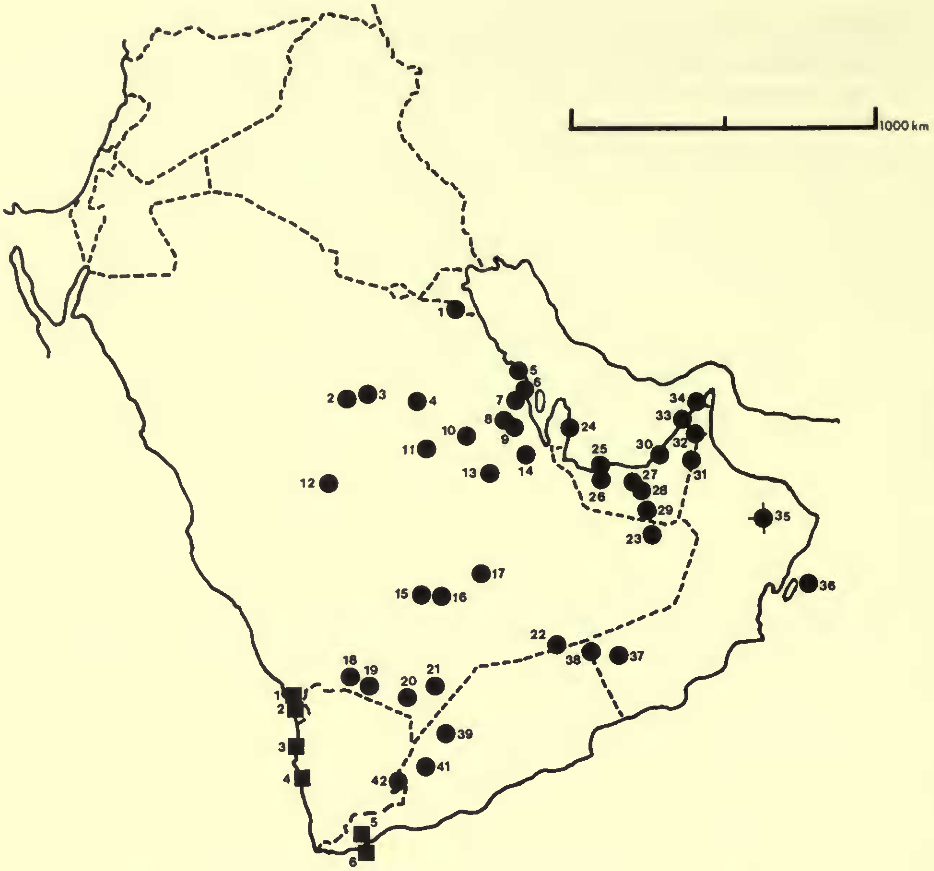

FIG. 7. *S. mitranus* and *S. hemprichii:* localities. Figures refer to entries in lists of material examined.

● – *S. mitranus.*

■ – *S. hemprichii.*

DEMOCRATIC REPUBLIC OF YEMEN

39. Zamakh, north Jol, Hadhramaut ; BM 1953.1.7.18.19*–23 ; ♂, 2♀♀, 3 juv.
41. Shabwa (= Shabwah), Hadhramaut ; FMNH 18460 ; juv. (type of *S. arabicus*).
42. Wadi Beihan ; FMNH 18459 ; juv. (paratype of *S. arabicus*).

IMPRECISE OR ERRONEOUS LOCALITIES

Oman ; BM 1950.1.4.75–77 ; ♂, 2♀♀.

Rub-al-Khali desert (collected by H. StJ. Philby on his traverse of the desert ; see Philby (1933) for his route) ; BM 1932.10.1.92*, 93*–9 ; 4♂♂, 2♀♀, juv.

S. Hejaz (see comment on this locality under *S. s. conirostris*, p. 224) ; BM 1938.2.1.65*–6 ; 2♂♂.

Arabia ; BM 1904.3.25.1 ; ad.

Hubb (= Hab) Plains, Sind (see comment on p. 229) ; BM 86.6.30.52/1946.8.20.58, 87.9.22.42/1946.8.20.59 ; 2 ad. (two of the types of *S. arenarius*).

Scincus hemprichii Wiegmann

Scincus hemprichii Wiegmann, 1837 : 128. Type locality : 'Abyssinia' (aus Massaua in Abyssinien' [= Massawa, Ethiopia] – fide Peters, 1865). Location of type : Zoologisches Museum der Humboldt Universität zu Berlin (Registered number : ZMB 1179).

Scincus (*Pedorychus*) *hemprichii* Peters, 1865 : 44.

DIAGNOSIS. Head large and broad ; external ear orifice minute, placed well below the level of the line made by the lower edges of the upper labial scales, and completely hidden by a large, smooth-edged scale ; eye with large cornea and a pupil that is vertically slit-shaped when contracted. Rostral scale separated from frontonasal by internasals ; frontoparietals in limited contact or separated ; parietals large (usually about twice the length of adjoining nuchals, or more). Dorsal scales ridged in adults ; mid-dorsals often distinctly larger than mid-ventrals ; 22–24 scales around mid-body. Dorsal pattern of adults and young consists of narrow, pale transverse bands on brownish ground ; no dark bars or spots present on flanks.

Auditory meatus quite long with at most a few scale vestiges distally and, proximally, a short triangular cartilage in its lateral wall. Extrastapes large and ovoid. Premaxillary rostrum short. Otic capsule huge, squamosal sharply flexed, its upper border forming a distinct spur posteriorly. Distal section of supratemporal process of parietal narrowed, terminating well above level of ventral tip of squamosal.

EXTERNAL FEATURES. Head large, distinctly broader than neck and much broader than body at level of forelimbs ; length in mature animals may be about 24–30% of snout to vent distance ; width about 55–70% of head length. Snout often broad in adults, its sides at least slightly convex when viewed from above. Top of head rises relatively steeply from snout-tip, more so than in *S. mitranus*. Canthus rostralis very weak or absent ; loreal region only slightly concave. Tail approximately cylindrical in cross-section, slightly compressed laterally towards tip ; about 50–60% of snout to vent distance in adults, up to 70% in juveniles.

Rostral overhangs mental less than in most other *Scincus*, and is separated from frontonasal by internasals. Prefrontals in contact, unfused. Frontal rather wider in front than behind. Frontoparietals either meeting narrowly or separated (in one case, fused to frontal). Interparietal kite-shaped, often rather elongate, occasionally separating first pair of nuchals. Parietals relatively large, about 1·7 to 3 times as long as first pair of nuchals. Supraoculars usually 6 : 6 (sometimes reduced to 5, at least unilaterally) ; supraciliaries typically four on each side (but three to seven may be present).

Nostril round, oval or slightly crescentic ; rostral excluded from its border. Usually three loreals on each side (but only two in one individual) ; if present, first loreal is separated from frontonasal. Upper labials deep (third is 2·3 to 3 times depth of second loreal) ; typically eight on each side but number varies from seven to nine. Ear orifice minute and situated well below level of line made by lower edges of upper labials ; completely hidden by smooth-edged scale that is larger than neighbouring ones.

Typically four or five pairs of nuchals (although counts may vary from two to five on each side). Dorsal scales more or less smooth in juveniles but ridged in older animals (two or three ridges on each scale, the ridging being strongest towards the posterior edge) ; mid-dorsals distinctly wider than mid-ventrals. 22 to 24 scales around mid-body. Row of laterally expanded scales on dorsal midline of tail well developed, extending proximally beyond level of extremities of posteriorly adpressed hindlimbs.

Parts of scales forming posterior digital fringes relatively narrow and pointed. Claws and ungual lamellae not strongly expanded laterally.

COLOUR AND PATTERN. In young animals, most dorsal scales are some shade of brown with a darker edge. These are interspersed by irregular transverse bands of paler scales, usually bearing opaque, whitish pigment, especially towards their posterior borders. This basic coloration is retained by many adults, but the dark scale edges tend to disappear and the whole pattern may sometimes fade. Nuchal area tends to be darker than the rest of back, and ground colour and intensity of pattern vary as does the number of light transverse bands. There may be one on the neck, from six to ten on the body and at least indications of more on the proximal part of the tail. Northern populations tend to have fewer bands on the body than southern ones (six or nine as against eight to ten). Dorsal pattern fades on flanks, which lack dark vertical bars or spots. Underside whitish or cream. Iris dark brown.

In life, there is often some pale yellow on the flanks, legs and belly. Snout and extremities of limbs are usually pinkish.

EYE. Cornea large, about 47–58% of horizontal diameter of eye (n = 3). Contracted pupil a vertical slit.

EAR (Fig. 3). Meatus quite long with only a few vestiges of scales in its distal section, which is membranous ; cartilage in lateral wall of upper portion is short and bluntly triangular. Tympanum relatively small (compared with skull length) ; distal section on extrastapes large and ovoid, occupying much of the tympanic area. Stapes robust, with a large foot-plate.

SKULL (Fig. 3). Premaxillary rostrum present, but short. Squamosal strongly flexed and there is a well-developed upward spur bordering the supratemporal process of the parietal. The surface exposure of the latter is abruptly reduced at about this point and it continues downwards as a narrow rod to terminate well above the level of the ventral tip of the squamosal. Supratemporal bone relatively large. Otic capsule huge, extending forwards almost to epipterygoid bone and backwards well beyond the supratemporal process of the parietal. About 20 teeth in each maxilla and mandible.

SIZE. Adult males considerably larger than adult females. Five largest males examined, 138 mm, 138 mm, 131 mm, 130·5 mm and 126 mm snout to vent ; the three largest females 108 mm, 95 mm and 95 mm. Smallest juvenile examined is 44 mm.

GEOGRAPHICAL VARIATION. Apparently some in markings ; see above.

DISTRIBUTION (Fig. 7). Known with certainty only from the extreme southwest of the Arabian Peninsula. All localities are in the coastal lowlands, from Sabya

(Asir Province, Saudi Arabia) through western Yemen to the Aden region of the Democratic Republic of Yemen.

There is also a slight possibility that *S. hemprichii* occurs on the western coast of the Red Sea. The type was obtained by Ehrenburg and Hemprich during their travels in northeast Africa and Arabia in the early 1820s. It was said to come from the Ethiopian area ('habitat in Abyssinia' – Wiegmann, 1837) and more specifically from Massawa, Eritrea ('aus Massaua' – Peters, 1865), but in the 150 years since the type was collected, no further *Scincus* appear to have been found in the Horn of Africa (i.e. Ethiopia including Eritrea, French Territory of Afars and Issas and the Somali Republic). As *Scincus* are often fairly conspicuous where they occur, this may indicate that the type locality of *S. hemprichii* is incorrect. Ehrenburg and Hemprich also collected in southwest Arabia, so there might have been some confusion over the origin of the type. It seems best, for the present, to treat the northeast African occurrence of *S. hemprichii* with caution.

MATERIAL EXAMINED (n = 31). Abbreviations are explained on p. 191 and localities are shown in Fig. 7.

SAUDI ARABIA

1. Sabya, 17°07'N 42°35'E ; BM 1964.301 ; ♀.
1. Near Sabya, 17°09'N 42°36'E ; CAS 134131–4.
1. Hakiwah, 17°01'N 42°50'E, 60m ; BM 1976.1858 ; ♂.
1. Khasawiyah, Wadi Damad, 17°00'N 42°07'E, 30m ; 2 ads., juv. Unregistered live specimens.
2. Ras-al-Bourge, Jizan, 16°53'N 42°32'E ; CAS 134154–6, 134161, 134164–5.
2. Matri Wells, 22 km east of Jizan, 16°58'N 42°42'E ; CAS 119221.
2. South of Matri Wells, 16°58'N 42°44'E ; CAS 119222.

YEMEN

3. Near Zohra (= Az Zuhra) ; BM 1963.799–800*, MCZ 112245 ; 2♀♀, juv.
4. 1 mile [1.6 km] east of Hodeida ; FMNH 66311 ; ♀.

DEMOCRATIC REPUBLIC OF YEMEN

5. Haithalhim ; BM 95.5.23.77* ; ♀.
5. Laheg (= Lahej), Aden ; BM 95.5.23.78 ; ♂.
5. Lahej and south to Sheikh Othman ; BM 99.12.13.76–7 ; 2♂♂.
6. Sheikh Othman ; BM 99.12.13.78, 79*–81 ; ♂, 3 juv.
6. Aden ; SMF 21657 ; ♂.

DOUBTFUL LOCALITY

'Abyssinia' ('aus Massaua' – fide Peters, 1865) ; ZBM 1179 ; ♂.

SPECULATIONS ON THE HISTORY OF THE GENUS *SCINCUS*

Relationship of Scincus *to other skinks*

Scincus is primarily an active forager on the surfaces of desert dunes and their perimeters. As such, it occupies a unique adaptive niche amongst the skinks. Some other groups, e.g. *Sphenops* Wagler 1830 and some members of *Ophiomorus* Duméril & Bibron, 1839 and *Typhlosaurus* Wiegmann, 1834, also inhabit sandy desert environments, but they tend to be long-bodied and more or less cryptic, spending a great part of their life below the sand surface rather than submerging intermittently, mainly as an antipredator device, as *Scincus* does.

Scincus has a number of features that appear to be almost certainly primitive (plesiomorphic in Hennig's terminology) within the Scincidae. These include an unmodified palate, in which the palatine bones are not in contact, unfused frontal bones, a full complement of skull elements, pterygoid teeth, an open Meckel's groove, an unelongate body, well developed limbs, an unmodified postcranial skeleton, and nostrils set between nasal scales and not broadly bordered by, or incorporated in, the rostral. Furthermore, at least one member is egg-laying rather than live-bearing (*S. scincus*). Greer (1970) provides arguments for the primitiveness of these characters. The first two features place *Scincus* within Greer's subfamily Scincinae. Some of the modern members of this assemblage appear to be close to the stock from which the other three subfamilies of the skinks recognized by this author were derived. The only other genera that have all these unspecialized features are *Eumeces* and *Scincopus*. Like *Scincus*, they have a high number of supraocular scales (often six) ; from its correlation with numerous other features believed to be primitive, it seems possible that this is also an unspecialized feature.

The characters of *Scincus* that appear to be apomorphic within the skinks include fusion of the postorbital and postfrontal bones, fusion of the originally paired premaxillae and a wide range of features showing clear functional association with life in loose sand, such as fringed digits, spatulate snout supported by a bony premaxillary rostrum, modified ears, valvular nostrils, countersunk jaw etc. The bone-fusion characters occur sporadically in a number of disparate scincid groups and may well have been developed several times. Some other skink genera that live in dune habitats also have sand modifications, but their resemblance to *Scincus* in these features seems to be superficial and is likely to be a result of convergence or parallelism. A number of factors suggest this. (1) Sand modifications tend to differ in detailed structure from group to group indicating that they are probably not a result of recent common ancestry. Thus, although sand-dwelling *Sphenops* and *Ophiomorus* have spatulate snouts, they lack the bony supporting rostrum of *Scincus*. Similarly, while nostrils tend to be crescentic and valvular, the arrangement of the scales surrounding them varies considerably and, although all the groups have the ear structure modified to protect the tympanum and probably to improve the reception of subterranean vibrations, the way this is done is not precisely the same. (2) Sand habitats are known to be powerful producers of striking convergences in lizards and a number of lizard families (e.g. Agamidae, Iguanidae, Lacertidae, Scincidae, Gerrhosauridae) have developed a range of analogous structures in this environment. So, parallelism or convergence within a single family, such as the skinks, would not be unexpected. (3) When sand-related characters are set aside, the other sand-dwelling skinks do not have a close resemblance to *Scincus* in other features.

Because of the strong possibility of convergence in many apomorphic characters, it is not possible, on present evidence, to relate *Scincus* certainly to any other scincid genus on the basis of these features. Nor is *Scincus* likely to be identical with, or very similar to, a stock that has given rise to any other modern genus, for some of its apparently apomorphic features (e.g. fringed digits, and bony premaxillary rostrum) seem to be unique in the family. But it appears worth enquiring whether either of the genera with which *Scincus* shares numerous plesiomorphic features could be considered close to the line that produced it. As will be shown, there are reasons for disqualifying *Scincopus* (see below), leaving only *Eumeces* to be considered. It has already been suggested (Greer, 1970) that its members are among the most primitive of living skinks. The genus is Holarctic in distribution and the American and east Asian species appear to be closely related to each other, but the rest of the genus, which is separated by a hiatus in central Asia, seems to stand apart. It comprises only *E. taeniolatus* and the *E. schneideri* group. *E. taeniolatus* is rather aberrant in having an elongate habitus and a row of expanded scales on the vertebral midline, but the *E. schneideri* complex, especially *E.* (*s.*) *algeriensis*, has more overall similarity to *Scincus* than the rest of the genus does. A distinct, although small meatal cartilage is present, at least in the young (also found in some other species of *Eumeces* and in some other scincines, e.g. *Chalcides*) and the ear opening is often partly protected by two scales, the upper overlapping the lower, as in *Scincus*. Whereas the dorsal pattern of most *Eumeces* consists of longitudinal stripes in the young, which are often retained by adults, *E.* (*s.*) *algeriensis* is peculiar in having irregular transverse banding, consisting of areas of scales bearing dark and light spots separated by regions of light scales that are orange or yellow in life. Although the bands are more numerous than in any *Scincus*, this pattern is generally reminiscent of that found in banded *Scincus* and it is likely that the latter could be derived from it. Also, while the diploid chromosome number of all nine east Asian and American species of *Eumeces* investigated to date is 26, that of *E.* (*s.*) *schneideri* is 32, the same number that occurs in *S. scincus*, the only *Scincus* that has been karyotyped so far (Gorman, 1973). Although *E.* (*s.*) *algeriensis* has not yet been checked, it seems likely that it will have a similar count to *E.* (*s.*) *schneideri*. Other factors that enhance the case for *E.* (*s.*) *algeriensis*-like skinks being ancestral to *Scincus* include the following. (1) This form and other west Palaearctic *Eumeces* seem to be better adapted to life in arid areas than most other members of the genus. (2) The distribution of the *E. schneideri* complex borders that of *Scincus*, running along the northern edge of the range of that genus. (3) There is palaeontological evidence that skinks generally similar to the members of the *E. schneideri* complex may have been at least intermittently present in northwest Africa for a long time, possibly since at least the Miocene (Hoffstetter, 1961). So, while it would be foolhardy to state categorically that *E.* (*s.*) *algeriensis* is identical with, or very closely related to, the precursor of *Scincus*, it is at least apparent that the *Eumeces schneideri* complex has been capable of giving rise to a form with the qualifications to be expected in a *Scincus* ancestor.

Scincopus occupies similarly arid habitats to *Scincus* (but apparently not very mobile sand systems) and is sympatric with it in northern Africa, but the following specialized features exclude it as a forefunner of the latter genus.

1. As in *Scincus*, the ear opening is well protected, but this is brought about not by lengthening the meatus but by the great enlargement of the two scales that overlap the opening. Furthermore, no meatal cartilage appears to be present.

2. *Scincopus* is nocturnal and has a vertically elliptical pupil and a large cornea. These features are found in *Scincus hemprichii*, but are absent in the most primitive constituent of the genus, the *S. scincus* complex (see below), and in the remaining species, *S. mitranus*, as well. This suggests that their presence in *S. hemprichii* is a secondary development and that the precursor of *Scincus* lacked them.
3. *Scincopus* lacks any obvious sexual dimorphism in size, yet this feature is present both in *Scincus* and *Eumeces*.
4. Like many *Scincus*, *Scincopus* has dark transverse bars on the dorsum, but their arrangement differs. The first body band is behind the level of the forelegs and not roughly coincident with them ; there are only four bands between the forelegs and the vent region (minimum of five in *Scincus*) and they extend to the tail tip.

All four features of *Scincopus* seem to be derivable from conditions found in *E.* (*s.*) *algeriensis*, as are equivalent characters of primitive *Scincus*. However, the specialized characters found in the latter do not appear to be derivable from those occurring in *Scincopus*, or *vice versa*. In view of this, it is best to regard both *Scincus* and *Scincopus* as independent derivatives of a *E.* (*s.*) *algeriensis*-like stock.

Interrelationships of the species of Scincus

In this discussion, the *S. scincus* complex will be treated as a single unit. The main characters known to vary between the members of the genus *Scincus* are set out in Table 5 and compared with the conditions present in *Eumeces* (*s.*) *algeriensis* which, it has been suggested, may well be similar to the stock that gave rise to *Scincus*. In most cases, the character states found in *E.* (*s.*) *algeriensis* are quite widespread in the Scincidae as a whole and often in other scincomorph groups as well. This, together with the presumed similarity of *E.* (*s.*) *algeriensis* to the ancestor of *Scincus*, suggests that alternative states in the latter genus are apomorphic and that states identical with, or similar to, those of *E.* (*s.*) *algeriensis* are plesiomorphic. It will be seen that the *S. scincus* complex has by far the most characters that are like their counterparts in *Eumeces*, or that approach closer to these counterparts than do those of other *Scincus* species (see section A of Table 5 for summary). This is true for 21 out of 23 characters in the *S. scincus* complex, but for only five in *S. mitranus* and eight in *S. hemprichii*, which indicates that the *S. scincus* complex is the most primitive constituent of the genus.

It seems likely that the two more specialized species were derived from a form generally similar to *S. scincus* and very doubtful that they had a separate origin from a very much more primitive form. Of the characters tabulated (see section B of Table 5), they have a number that are more similar to those of *S. scincus* than to those of *Eumeces*, but very few, or none, where the reverse is true. In the case of *S. mitranus*, 11 out of 23 characters are about equally similar to the conditions found in *S. scincus* and *Eumeces*, 12 are more similar to *S. scincus* and none is more similar to *Eumeces*. In the case of *S. hemprichii*, 16 out of 23 are equally similar, six are more similar to *S. scincus* and only one is more similar to *Eumeces*. However, to gain a real idea of the greater relative similarity of these species to the *S. scincus* complex rather than to *Eumeces*, the characters common to all *Scincus*, but absent in

Eumeces, must be included, viz. fuzed premaxillae, fused postfrontal and postorbital bones and the extensive range of adaptations to life in loose sand.

Having assumed an origin from a *S. scincus*-like form, it remains to inquire how *S. mitranus* and *S. hemprichii* are related to each other. Two extreme possibilities exist: (1) they arose as a common stock that evolved a substantial number of apomorphic characters before they diverged, or (2) they arose as independent derivatives of a *S. scincus*-like form. If the first possibility were true, it would be expected that *S. mitranus* and *S. hemprichii* would share a high proportion of the apomorphic characters that they possess relative to *S. scincus*. Also, it is likely that their overall resemblance to each other would be greater than the overall resemblance of each to the *S. scincus* complex. When apomorphic characters are considered, it will be seen that both *S. mitranus* and *S. hemprichii* show similar apomorphic trends in characters 1, 2, 4, 5, 6, 7, 9, 10, 11 and 19, but in characters 3, 12 and 18 only *S. mitranus* is apomorphic and in characters 8, 13, 14, (15), 17 and 21 this is true only of *S. hemprichii*. So shared trends make up only just over half of the total apomorphic features shown by *S. mitranus* and *S. hemprichii*.

It could be argued that these shared apomorphic trends developed in common before divergence. But, apart from character 19 (extension of the mid-dorsal scale series of the tail), all are confined to one organ system, the ear and associated structures. As has been pointed out, a number of skink stocks show similar adaptations of the ear to sandy habitats, so parallel development in *S. mitranus* and *S. hemprichii* would not be impossible. Although both species show similar apomorphic trends in the ear, these are developed to different extents. Thus, *S. mitranus* is more specialized in characters 2 and 3 and *S. hemprichii* in 1, 4, 5, 6, 7, 8, 9, 10 and 11. Therefore the amount of development that could have occurred in a common stock is quite restricted.

Estimation of overall resemblance also indicates that any common origin that *S. mitranus* and *S. hemprichii* had from *S. scincus*-like skinks must have been limited. Comparisons of the three species pairs within *Scincus* are given below.

	Identical features	Features most similar in given pair
S. scincus – S. mitranus	10	11
S. scincus – S. hemprichii	6	3
S. mitranus – S. hemprichii	0	9

Thus, on the basis of identical characters, there is little resemblance between *S. mitranus* and *S. hemprichii*, whereas both of these have considerable affinity to *S. scincus*. If the (less important) features of comparative similarity are also taken into account, the clarity of the arrangement is somewhat reduced, but there are still no grounds for thinking of *S. mitranus* and *S. hemprichii* as being closer to each other than to the *S. scincus* complex.

In summary, it seems likely that *S. mitranus* and *S. hemprichii* either had a very restricted common evolution from the *S. scincus* complex or none at all, and that there was parallel development of some ear characters.

TABLE 5

Characters showing variation among the species of *Scincus*. *Eumeces* (*schneideri*) *algeriensis* is included for comparison

Character	*Eumeces algeriensis*	*Scincus scincus**	*Scincus mitranus*	*Scincus hemprichii*		A			B	
						*S. scincus**	*S. mitranus*	*S. hemprichii*	*S. mitranus*	*S. hemprichii*
Ear and associated parts of skull										
1. External orifice	large	small	very small	minute	1.	+	—	—	s	s
2. External auditory meatus	very short	short	long	fairly long	2.	+	—	—	s	s
3. Meatal cartilage	very short	short	long	short	3.	+	—	+	s	s
4. Scaling in meatus	well developed	well developed	reduced	very reduced	4.	+	—	—	=	=
5. Quadrate (relative degree of deviation from condition in *Eumeces*)		1	2	3	5.	+	—	—	s	s
6. Extrastapes	slender bar	slender bar	elongate plate	large, ovoid plate	6.	+	—	—	=	=
7. Stapes	slender	slender	rather more robust	robust	7.	+	—	—	=	=
8. Otic capsule	normal	normal	normal	huge	8.	+	+	—	=	=
9. Squamosal bone	gently curved	gently curved	flexed, sometimes with small spur	flexed, with spur	9.	+	—	—	=	=
10. Tip of supratemporal process of parietal relative to tip of squamosal	level	level	above	well above	10.	+	—	—	=	=
11. Supratemporal bone	small	small	larger	larger still	11.	+	—	—	=	=
12. Premaxillary rostrum	none	moderate	large	small	12.	—	—	+	s	=

Eye											
13.	Pupil	round	round	round	vertical	13.	+	+	—	=	=
14.	Cornea	small	small	small	large	14.	+	+	—	=	=
Scaling											
15.	Scales around mid-body	(28) 30–34	24–30	(25) 26–30	22–24	15.	+	+	—	s	s
16.	Rostral–frontal contact	no	yes/no	yes	no	16.	+	—	+	s	=
17.	Frontoparietal contact usually broad	yes	yes	yes	no	17.	+	+	—	=	=
18.	Parietals usually large	yes	yes	no	yes	18.	+	—	+	=	=
19.	Mid-dorsal caudal series	very short	short	moderate	long	19.	+	—	—	s	s
20.	Head width in large individuals	wide	wide or narrow	narrow	wide	20.	+	—	+	s	=
Colouring											
21.	Dorsum of young	banded	plain	plain	banded	21.	—	—	+	s	E
22.	Dorsum of adults	banded	banded or plain	plain	banded	22.	+	—	+	s	=
23.	Bars on flanks	no	yes/no	yes	no	23.	+	—	+	s	=

A. Comparison of species of *Scincus* with *E. algeriensis*.
+ : denotes closest similarity to condition in *E. algeriensis*.
B. Comparison of characters of *S. mitranus* and *S. hemprichii* with those of *S. scincus* and *E. algeriensis*.
s : greater similarity to *S. scincus*.
E : greater similarity to *E. algeriensis*.
= : approximately equal similarity to these two species.
* used in its broadest sense for the whole *S. scincus* complex.

Origin of species distribution pattern

It has been suggested above that the widespread *S. scincus* complex is the most primitive component of the genus and that the Arabian species, *S. hemprichii* and *S. mitranus*, either are each independent derivatives of a *S. scincus*-like stock, or had only a restricted common history. This pattern of speciation and distribution may partly stem from changes in the map of aridity during the Quaternary. Just as fluctuations in the extent of the South American rain forest are thought to have promoted speciation in the iguanid *Anolis chrysolepis* group (Vanzolini & Williams, 1970), so the contraction and fragmentation of the desert areas of the Saharan–Arabian region, followed by their renewed expansion, could be seen as a crucial factor in the differentiation of the species of *Scincus*. If the Saharan–Arabian deserts were originally occupied by populations similar to the present *S. scincus* complex, change to more mesic conditions would have fragmented this continuum into a series of isolates. The area of aridity would have undoubtably contracted and this is likely to have severed contact between the African and Arabian deserts through Sinai. It is also possible that the contraction of dry areas may have separated the main southern Arabian desert from the arid southwestern coastal strip of the peninsula. Today, these two dry areas are largely divided by high mountains and a relatively modest extension of mesic conditions would have isolated them completely. Another factor that may be important in separating the *Scincus* of extreme southwestern Arabia from the rest is the presence of geophysical barriers that interrupt the Tihama, the sandy plain running along the western seaboard of Arabia. At the present time this is crossed by extensive gravel fans that probably do not provide suitable habitats for *Scincus* and south of these, at about latitude 18°30'N, is the Harrat Habhab, a large lava flow. Although this is now largely covered by sand, it could have been important in isolating the *Scincus* of southwestern Arabia in the past. Alternatively, if its origin predates their isolation, the populations might have been continuous around its outer edge during a period of lowered sea level but became isolated when this rose.

Whatever the details of the situation in southwest Arabia, it seems feasible that the once more or less continuous Saharan–Arabian desert became divided into at least three separate refuges (or complexes of refuges) in which the present *S. scincus* complex, *S. mitranus* and *S. hemprichii* differentiated. If arid conditions then again became widespread, the three allopatric units so formed would have been inclined to expand, although, as has been suggested, the southwest Arabian *S. hemprichii* was probably restricted by geomorphological features. It is to be expected that such range extension would have been initially greatest among populations that were not strictly adapted to very arid habitats, since the more mesic areas surrounding the refuges would not dry out immediately.

On this premise, one might predict that *S. scincus* would be the first to spread, for morphological evidence and the limited ecological data available suggest that it is less strictly adapted to very arid conditions than *S. mitranus* and *S. hemprichii*. This seems to have been the case, for *S. scincus* now occurs in both North Africa and Arabia and it seems likely that it spread eastwards through the Sinai area, with the onset of drier conditions, and invaded much of the Arabian peninsula.

However, this advance into Arabia appears subsequently to have been partly reversed by expansion of the endemic *S. mitranus*. The most southern and eastern populations of *S. scincus* in the peninsula, *S. s. conirostris*, occur very close to (or in actual contact with) *S. mitranus* at a number of places including Kuwait, Abqaiq, Dhahran, eastern United Arab Emirates (Ra's al Khaymah and Jazirat al Hamra) and Hadhramaut. All these localities are on the periphery of the range of *S. mitranus* and no *S. s. conirostris* are presently known from the more central parts of its distribution, nor do populations of *S. mitranus* seem to occur far within the range of *S. scincus*. This suggests that the two species are not usually capable of existing in close and stable sympatry. The areas where they do occur together appear to be localities where really desertic areas, with extensive moving sand, border rather more mesic territory with a more stable sandy substrate. In such places, *S. mitranus* appears to occupy the former regions and *S. s. conirostris* the latter. This seems to be the situation in the eastern United Arab Emirates. Here *S. mitranus* was the sole form encountered in large dune systems and *S. s. conirostris* was seen only in an area of mainly stabilized sand ridges. Even in this area, the few mobile sand slips were occupied by *S. mitranus*. Similarly, in the Hadhramaut, *S. mitranus* is known from the sand sea or its edges, whereas *S. s. conirostris* appears to occur in the more stable areas of Wadi Hadhramaut itself.

It might be thought that *S. scincus* was merely halted by ecological exclusion when it reached the periphery of the range of *S. mitranus*. But at least one population of *S. scincus conirostris*, that in the eastern United Arab Emirates, is now apparently completely isolated, and in the comparatively well-worked area between it and the nearest other known population (Abqaiq), only *S. mitranus* is known. It is possible that some of the other *S. s. conirostris* localities such as those in the Hadhramaut are also cut off in this way. Such relicts suggest that *S. scincus* has actually lost ground to *S. mitranus* in Arabia.

As stated, most records of *S. s. conirostris* come from the periphery of the range of *S. mitranus* and it may be that some of the characteristic features of this subspecies have arisen from this contact by character displacement (in the sense of Brown & Wilson, 1956) or at least have been maintained by it. Certainly *S. mitranus* has more characters in common with the allopatric *S. s. meccensis* of west and north-western Arabia than it does with *S. s. conirostris*. In contrast to the latter, it shares with *S. s. meccensis* a narrow head in adults, a strongly spatulate snout with well-developed rostral-frontonasal contact and dark bars on the flanks. As we have seen, *S. mitranus* appears to exclude *S. s. conirostris* from the extensive loose-sand habitats that are typical of the genus *Scincus* and some of the characteristic features of *S. s. conirostris* appear to reflect this. In most populations of *Scincus*, the head is relatively narrow and this seems to be functionally important in sand-diving. However, in areas with relatively limited loose sand this feature may well be at a lower premium and the advantages of a bigger, broader head, typical of many skinks, would assert themselves. A shorter, less spatulate snout which does not involve well-developed rostral-frontonasal contact, can be 'explained' in a similar way. The bars on the flanks of *Scincus* seem to be important sign-stimuli and captive *S. mitranus* often appear to assume a position where they are conspicuously displayed to other individuals. In areas of sympatry, species recognition would be enhanced if one species had bars and the other did not.

It might be argued that if the characters of *S. s. conirostris* are a result of displacement, then neighbouring populations of *S. scincus* not in contact with *S. mitranus* should lack them. This is largely so since they are missing in the adjacent *S. s. meccensis*. The only *S. s. conirostris* outside the known range of *S. mitranus* occur to the north in a relatively small area of Iran, Iraq and extreme northern Arabia. These retain all the characters diagnostic of *S. s. conirostris*, possibly partly because the area contains no really extensive dune systems such as are occupied by *S. s. meccensis* and *S. mitranus* so there is no strong pressure to develop the features typical of these forms. This allopatric area may represent a relatively recent extension of the range of *S. s. conirostris*.

Although the basic pattern of speciation and distribution of *Scincus* can be interpreted in terms of three refuges and two arid periods separated by a more mesic one, it is likely that the history of the genus has been more complex. Certainly, the climatic fluctuations must have been more complicated than suggested here. Palaeoclimatologists no longer adhere to a simple scheme of progressive low-latitude desiccation following a 'pluvial' corresponding to high-latitude glaciation, and are indeed reluctant to assume that any episode of moister conditions was felt throughout the area under discussion. Nevertheless, the reality of such changes is accepted (see, e.g., Butzer, 1972). Also, it seems possible that at least some of the main desert refuges were divided further during the most mesic climatic phases. Such subdivision would help explain the high level of variation in the North African *S. scincus* complex.

If the above explanation of the origin of the pattern of speciation and distribution in *Scincus* is valid, it would be expected that other animal groups with similar general requirements should show a similar pattern. Unfortunately, most other Saharan–Arabian lizard groups are in need of thorough revision, but analogies to the *Scincus* situation can be found in the gekkonine genus *Stenodactylus* and in the lacertid, *Acanthodactylus scutellatus* group (see Table 6). Both these assemblages contain desert-adapted species largely associated with sandy habitats. In *Stenodactylus*, the species often show the same basic distributions as those of *Scincus*, there being one occurring in both North Africa and Arabia, three confined to Arabia excluding the southwest of the peninsula and two confined to the southwest. In

TABLE 6

Species distribution of some mainly sand-dwelling lizards in the Saharan Arabian desert area.

Genus	North Africa and north Arabia	Arabia only, but not southwestern coast	Southwestern coast only
Scincus	*S. scincus* complex	*S. mitranus*	*S. hemprichii*
Stenodactylus	*S. sthenodactylus*	*S. slevini* *S. doriae* *S. arabicus*	*Stenodactylus* n. sp. *S. pulcher*
Acanthodactylus	*A. scutellatus*	*A. arabicus schmidtii*	*A. arabicus arabicus*

the *Acanthodactylus scutellatus* species group, *A. scutellatus* is North African, with one population, *A. s. hardyi*, entering northern Arabia, while at least one form, *A. arabicus** is confined to Arabia and has a distinctive subspecies in the southwest.

SUMMARY OF SYSTEMATIC CONCLUSIONS

Scincus can be divided into three clear entities as follows.

1. *Scincus mitranus* is confined to Arabia, but is absent from the west and southwest of the peninsula. Its synonymy includes *S. arabicus*, *S. arenarius*, *S. muscatensis*, *S. philbyi* and *S. richmondi*. *S. mitranus* shows considerable geographical variation: specimens from southeastern Oman and from the north of the range have distinctive features, but judgement is reserved as to whether distinct subspecies should be recognized. The Pakistan record of *S. mitranus*, under the name *S. arenarius*, is considered to be erroneous.
2. *Scincus hemprichii* is probably limited to the coastal lowlands of southwestern Arabia and its supposed occurrence in Eritrea is doubtful. It is a very clearly defined species that exhibits little obvious geographical variation.
3. The *Scincus scincus* complex includes all other members of *Scincus* and occurs over nearly the whole known range of the genus, but is absent from southwestern Arabia. In North Africa, the populations fall into two groups, which may represent largely allopatric species for which the oldest names are *S. scincus* and *S. albifasciatus*. However, evidence for specific status is not conclusive. The *scincus* group of populations can be divided into *scincus s. str.* in Egypt and Israel and *cucullatus* in northeast Algeria, Tunisia and northwest Libya; animals from northeast Libya are intermediate. Isolated populations in southeast Algeria and northwest Nigeria also seem to belong to the *scincus* group, but cannot be allocated to either of the named forms. The *albifasciatus* group of populations consists of *albifasciatus s. str.* in West Africa, from Rio de Oro to Senegal and eastwards through Mali and Niger to southeast Libya, and *laterimaculatus* in northwest Algeria; the two forms appear to be connected by intermediates in southeast Morocco and in Mauretania.

In southwest Asia, the *Scincus scincus* complex is represented by two quite well-defined allopatric entities: *S. scincus meccensis* (incorporating *S. deserti*) in southern Jordan, northwest and west Arabia and *S. s. conirostris* (including *S. gasperettii*) in south and east Arabia, Iraq and southwest Iran.

It is also suggested that lacertid lizards in Arabia usually assigned to *Acanthodactylus cantoris* represent a distinct species for which the oldest name is *A. arabicus* Boulenger, 1919.

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* The Arabian lizards assigned to *Acanthodactylus cantoris* seem not to be conspecific with this form and have more affinity with *A. scuttellatus*. They are therefore recognized as a distinct species for which the oldest available name is *Acanthodactylus arabicus* Boulenger, 1919.

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REFERENCES

Anderson, J. 1871. Description of a new species of *Scincus*. *Proc. Asiat. Soc. Beng.* **1871**: 115–116.

—— 1896. *A contribution to the herpetology of Arabia with a preliminary list of the Reptiles and Batrachians of Egypt*. London, 122 pp.

—— 1898. *Zoology of Egypt: Reptilia and Batrachia*. London, lxiv+371 pp.

Angel, F. & Lhote, H. 1938. Reptiles et Amphibiens du Sahara central et du Soudan. *Bull. Com. Etud. hist. scient. Afr. occid. fr.* **21** (3): 345–84.

Anon. (= Anderson, J. ?) 1871. (Gift) from Babu Rajendralala Mitra – a dried specimen of a new species of *Scincus*. *Proc. Asiat. Soc. Beng.* **1871**: 96.

Arnold, E. N. (in preparation). A review of the genus *Stenodactylus* (Reptilia Gekkonidae).

—— 1977. Some little-known geckoes from Arabia with descriptions of two new species from the Sultanate of Oman. *Results of the Oman Flora and Fauna Survey, 1975.*

Badir, N. & Hussein, M. F. 1965. Effect of temperature, food and illumination on the reproduction of *Chalcides ocellatus* (FORSK.) and *Scincus scincus* (LINN.) *Bull. Fac. Sci. Egypt. Univ.* **39**: 179–185.

BAIRD, I. L. 1970. The anatomy of the reptilian ear. *In* Gans, C. *et al.* *Biology of the Reptilia*, vol. 2. London & New York, xv + 374 pp.

BENT, T. & BENT, M. V. A. 1900. *Southern Arabia.* London, xii + 455 pp.

BLANFORD, W. T. 1881. On a collection of Persian reptiles recently added to the British Museum. *Proc. zool. Soc. Lond.* **1881** : 677–682.

BOULENGER, G. A. 1890. First report on additions to the lizard collection in the British Museum (Natural History). *Proc. zool. Soc. Lond.* **1890** : 77–86.

BROWN, W. L. & WILSON, E. O. 1956. Character displacement. *Syst. Zool.* **5** (2) : 49–64.

BUTZER, K. W. 1972. *Environment and Archeology: an Ecological Appraisal of Prehistory.* London, 2nd ed., xxvii + 703 pp.

CHEESMAN, R. E. 1926 *In Unknown Arabia.* London, xvi + 447 pp.

DONNDORFF, J. A. 1798. *Zoologische Beyträge zur XIII. Ausgabe des Linneischen Natursystems*, vol. 3. Leipzig, 980 pp.

DUNGER, G. T. 1973. The lizards and snakes of Nigeria. Part 7 : the skinks of Nigeria (continued and completed). *Niger. Fld* **38** (2) : 54–80.

EL-TOUBI, M. R. 1938. The osteology of the lizard *Scincus scincus* (Linn.). *Bull. Fac. Sci. Egypt. Univ.* **14** : 1–38.

GORMAN, G. C. 1973. The chromosomes of the Reptilia, a cytotaxonomic interpretation. *In* Chirelli, A. B. & Capanna, E. *Cytotaxonomy and vertebrate evolution.* New York.

GREER, A. E. 1970. A subfamilial classification of scincid lizards. *Bull. Mus. comp. Zool. Harv.* **139** (3) : 151–183.

HAAS, G. 1957. Some amphibians and reptiles from Arabia. *Proc. Calif. Acad. Sci.* **29** (3) : 47–86.

—— 1961. On a collection of Arabian reptiles. *Ann. Carneg. Mus.* **36** : 19–28.

—— & BATTERSBY, J. C. 1959. Amphibians and reptiles from Arabia. *Copeia*, **1959** (3) : 196–202.

HARTERT, E. 1913. Expedition to the Central Western Sahara : Reptiles and Batrachians. *Novit. zool.* **20** : 77–84.

HOFFSTETTER, R. 1961. Squamates. *In* Le gisement de vertébrés Miocènes de Beni Malal (Maroc). *Notes Mém. Serv. Mines Carte géol. Maroc* **155** : 95–101.

LAURENTI, J. N. 1768. *Specimen medicum, exhibens synopsin reptilium emendatum cum experimentis circa venana et antidota reptilium austriacarum.* Vienna, 214 pp.

LINNAEUS, C. 1758. *Systema naturae*, ed. 10, vol. 1. Stockholm, 11 + 824 pp.

MERTENS, R. 1972. Über den Senegal-Skink (*Scincus albifasciatus*) und seine Verwandten. *Salamandra* **8** (3/4) : 117–122.

MINTON, S. A. 1966. A contribution to the herpetology of West Pakistan. *Bull. Am. Mus. nat. Hist.* **134** (2) : 27–184.

MURRAY, J. A. 1884. *Vertebrate Zoology of Sind.* London & Bombay, xvi + 424 pp.

—— 1886. Description of an apparently new species of *Scincus* from Muscat. *Ann. Mag. nat. Hist.* (5) **17** : 67–68.

PASTEUR, G. & BONS, J. 1960. Catalogue des reptiles actuels du Maroc. *Trav. Inst. scient. chérif. Serie Zool.*, **21** : 1–132.

PETERS, W. 1865. Über die Eidechsenfamilie der Scincoiden insbesondere über die Schneider'schen Wiegmann'schen und neue Arten des zoologisches Museums. *Mber. K. preuss. Akad. Wiss.* **1864** : 44–58.

PHILBY, H. ST. J. B. 1933. *The Empty Quarter.* London, xxiv + 433 pp.

SCHMIDT, K. P. 1939. Reptiles and amphibians from Southwestern Asia. *Publs. Field Mus. nat. Hist.* (*Zoological Series*) **24** (7) : 49–92.

—— 1941. Reptiles and amphibians from Central Arabia. *Publs Field Mus. nat. Hist.* (*Zoological Series*) **24** (16) : 161–165.

SMITH, M. A. 1935. *Fauna of British India including Ceylon and Burma. Reptilia and Amphibia II – Sauria.* London, xiii + 440 pp.

STEINDACHNER, F. 1903. Batrachier und Reptilien aus Südarabien und Sokótra. *Sber. Akad. Wiss.* Wien, **112** (1) : 7–14.

THORPE, R. S. 1975. Biometric analysis of incipient speciation in the Ringed Snake, *Natrix natrix* (L.). *Experientia* **31** : 180–182.

TORNIER, G. *In* Ehrenberg, C. G. 1899. *Symbolae Physicae. Icones adhuc ineditae etc.* Berlin, 17 pp., 32 pl.

VANZOLINI, P. E. & WILLIAMS, E. E. 1970. South American anoles : the geographic differentiation and evolution of the *Anolis chrysolepis* species group (Sauria, Iguanidae). *Archos Zool. S. Paulo* **19** (1–2) : 1–124.

WERNER, F. 1914. Ergebnisse einer von Prof. F. Werner im Sommer 1910 mit Unterstützung as dem Legate Wedl ausgeführten zoologischen Forschungsreise nach Algerien. II. Vertebrata. *Sber. Akad. Wiss. Wien* (*Abt.* 1) **123** : 331–362.

WERNER, Y. L. 1971. Lizards and snakes from Transjordan, recently acquired by the British Museum (Natural History). *Bull. Br. Mus. nat. Hist.* (Zool.) **21** (6) : 213–256.

WIEGMANN, A. F. A. 1834. *Herpetologia Mexicana.* Berlin, vi + 54 pp.

—— 1837. Herpetologische Notizen. *Arch. Naturgesch.* **3** : 123–136.

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